11-1-1973

Ecology and the Economy, A Concept for Balancing Long-Range Goals, The Pacific Northwest Example

Pacific Northwest River Basins Commission. Urban and Rural Lands Committee

ECOLOGY AND THE ECONOMY

A CONCEPT FOR BALANCING LONG-RANGE GOALS

THE PACIFIC NORTHWEST EXAMPLE

PACIFIC NORTHWEST RIVER BASINS COMMISSION
1 COLUMBIA RIVER • P. O. BOX 908 • VANCOUVER, WASHINGTON / 98660

NOVEMBER, 1973

ECOLOGY AND ECONOMY

Prepared by
URBAN & RURAL LANDS COMMITTEE
PACIFIC NORTHWEST RIVER BASINS COMMISSION

ECOLOGY AND THE ECONOMY

TABLE OF CONTENTS

Table of Contents, (cont.)

FIGURES

TABLES

Table of Contents, (cont.)

PACIFIC NORTHWEST RIVER BASINS COMMISSION

1 Columbia River

P. O. Box 908 Vancouver, Washington 98660 Telephone (206) 694-2581 (503) 285-0467

OFFICE OF THE CHAIRMAN

FOREWARD

This report, "Ecology and the Economy, A Concept for Balancing Long-Range Goals, The Pacific Northwest Example," is a product of three years work by the Urban and Rural Lands Committee of the Pacific Northwest River Basins Commission.

Committee composition is of persons with knowledge and experience in many fields; it includes people from private enterprise as well as state and federal employees from the several northwest states.

The committee submitted the report to the Pacific Northwest River Basins Commission at its Helena, Montana meeting in July, 1973, at which time the commission agreed to "receive, print and distribute" the report.

Comments on this report are always welcome.

Donel J. Lang, Chairman
Pacific Northwest River Basins Commission

URBAN AND RURAL LANDS COMMITTEE

PACIFIC NORTHWEST RIVER BASINS COMMISSION

Name	*Agency or Organization*
Allen, Ernest E.	USDI, Bureau of Outdoor Recreation
Alspaugh, Alton	Pacific Power & Light Company
Arnold, Edwin L.	USDI, National Park Service
Arnold, Rudolf C.	U.S. Army Corps of Engineers
Baber, Kenneth D.	USDI, Bureau of Mines
Barker, Thomas L.	Wyoming State Engineer's Office
Carson, Harry	Board of Marion County Commissioners
Charlton, Dr. David B.	Charlton Laboratories
Clark, Dr. David	Portland State University
Davidson, John H.	Dept. of Commerce, Economic Development Admn.
Frazier, Larry	Mid-Willamette Valley Council of Governments
Geren, Harold E.	Environmental Protection Agency
Hidaka, Frank T.	USDI, Geological Survey
Johnson, Bruce	Skidmore, Owings & Merrill
Kaydas, George M.	Dept. of Commerce, National Marine Fisheries
Kramer, Donald	Idaho State Water Resource Board
Lloyd, Irvin C.	Federal Highway Administration
Monn, Robert H.	Washington State Department of Ecology
Moore, Norman H.	USDI, Bureau of Reclamation
O'Connor, Tom	Washington State Dept. of Natural Resources
Oleson, Amos L.	USDA, Soil Conservation Service
Parker, Jerry	Washington State Planning Division
Peterson, Eugene K.	USDI, Bureau of Land Management
Post, Warren A.	USDA, Forest Service
Reese, Donald H.	USDI, Bureau of Sport Fisheries & Wildlife
Rogers, Lloyd W.	USDI, Bureau of Indian Affairs
Sienkiewicz, Edward W.	USDI, Bonneville Power Administration
Smith, Glenn	Montana State Dept. of Natural Resources & Conservation
Stewart, Dr. Clyde E.	USDA, Economic Research Service
Tanino, Ry	U.S. Dept. of Housing and Urban Development
Trombley, Gordon C.	Idaho State Dept. of Public Lands
Westling, A.M.	League of Oregon Cities
Wyckoff, Dr. J.B.	Oregon State University

Pacific Northwest River Basins Commission staff members who devoted more than considerable time and effort to prepare this report deserve special recognition.

They are Rob Vining, Robert McNeil and Paul Benson; their contributions were substantial.

Mark Westling, Chairman
Urban & Rural Lands Committee

PREFACE

The Water Resources Planning Act of July 22, 1965 (Public Law 89-80),established a national policy of preparing long-range, comprehensive, and coordinated plans and implementation procedures for the "conservation, development, and utilization of water and related land resources of the United States." The Act specified that planning and implementation should be a joint undertaking by "all affected Federal agencies, States, local governments, individuals, corporations, business enterprises, and others concerned."

The Water Resources Council, which was established by the Act, outlined 20 geographic regions comprising the 50 states that would provide the planning base. Thus it became the only comprehensive resource planning organization that blankets the nation. The Act authorized the establishment of regional river basin commissions, after a request from the governors of the states involved, to coordinate the planning efforts for each of the 20 river basins. In the absence of commissions the planning is done by interagency committees.

The Pacific Northwest River Basins Commission was the first such commission in the nation. It was established by Presidential order on March 6, 1967, at the request of the Governors of the States of Idaho, Montana, Oregon, Washington, and Wyoming. On January 1, 1973, six such commissions had been established, but the Northwest commission was the only one west of the Rocky Mountains. The Commission has 16 members consisting of a representative from each of the five States and from nine Federal agencies: the Departments of Agriculture; Army; Commerce; Health, Education and Welfare; Housing and Urban Development; Interior; Transportation; Environmental Protection Agency; and the Federal Power Commission. The remaining two members are the U.S. Entity, Columbia River Treaty; and the Chairman and principal executive officer, who is appointed by the President of the United States.

One of the purposes of the Commission is to "prepare and keep up to date . . . a comprehensive, coordinated, joint plan for Federal, State, interstate, local and non-governmental development of water and related land resources." The Commission is responsible for the direction and coordination of the Columbia-North Pacific Type I Framework Study geared to the years 1980, 2000, and 2020, and for coordination of more detailed studies of the Willamette Basin and of the Puget Sound and Adjacent Waters. An organizational chart for the Commission is shown in Fig. 2.

To assist in different special fields, to explore and occasionally send up trial balloons before action is necessary, the Pacific Northwest River Basins Commission has established nine continuing technical committees. These are: Economic Studies; Fish and Wildlife; Hydrology and Hydraulics; Meteorology; Aquatic Plant and Insect Control; Water Supply and Water Pollution Control; Power Planning; Recreation; and Urban and Rural Lands. The newest of these is the Urban and Rural Lands Committee. It was established on October 16, 1969. It is also the first and only "lands" committee established by any of the river basin commissions or interagency committees. One of the functions assigned to this committee is to "Identify the significant interactions between people, economic development, land, water and other resources, and the environment." Another is to "Provide a forum for discussion

and exchange of information on matters pertinent to urban and rural land and environmental planning."

In furtherance of the above functions the committee decided in June 1970 to undertake completion of a paper that member E.K. Peterson had begun concerning long term relationships between resources, population, industry, and livability in the Pacific Northwest. A volunteer work group averaging about 12 members contributed substantially in the preparation, revisions, and reviews of several early drafts.

The committee members were concerned that projections of continued growth in population and economic activity in the Northwest would eventually lead to a major deterioration of the present high quality environment. They also were concerned that land, energy, and air resource planning was lagging far behind water resource planning. They decided to present a view of the future of the Northwest based upon attainable balances between ecology and economics as an alternative to traditional projections of economic growth alone. (Ecology, as the term is used in this study, refers to the relationship between humans and their physical environment, including other life forms.) This effort required more emphasis upon land resources than the primarily water oriented studies of the Commission.

Since there were no ready-made answers, the quest proved to be a major and very difficult undertaking. The fact that the committee had no budget and had to depend upon contributed time added to the difficulty.

The authors make no claim that the inter-disciplinary study meets the professional standards of any of the presently recognized scientific disciplines involved. The fact that both ecology and economics, as well as related fields of biology, natural resources planning and management, sociology, psychology, philosophy, and politics are inexact sciences, each with widely divergent internal viewpoints, makes such a goal virtually impossible of attainment. The use of synthesis and both deductive and inductive methods as well as the use of non-technical terms may cause some specialists to conclude that the study is not sufficiently rigorous from the point of view of their particular discipline. However, the authors feel that they have succeeded in pioneering a new dimension and basic new concepts in comprehensive long range planning methods—even though they may be at a relatively crude state of development. The final verdict, however, must await several years of testing and refinement, hopefully in the Northwest and several other regions also.

At its twenty-ninth meeting on December 2, 1971, the Commission after thorough discussion, authorized the duplication of a discussion draft of "Ecology and the Economy" after addition of the committee's analysis of methodology and reliability of numbers used. The Commission asked that the discussion draft be widely distributed with a request for

comments. It also agreed to review the document and the comments in about one year and take appropriate action. In September 1972, the 2000-copy supply of the discussion draft was exhausted.

The committee used a multi-media presentation to help explain the draft study to Commission members on December 2, 1971. In order to stimulate interest in the discussion draft, committee members during 1972 and the first six months of 1973 accepted invitations to repeat the presentation from 52 groups interested in long range resources planning (about 4,400 individuals). Twenty-four presentations were made in Oregon, 12 in Washington, 6 in Idaho, 4 in Montana, 2 in the District of Columbia, 1 in Toronto, Canada, 1 in Denver, Colorado, 1 in Minneapolis, Minnesota, and 1 in Los Angeles, California. They included 9 professional societies, 5 real estate development groups, 5 regional planning groups, 9 conservation organizations, 2 regional associations of governments, 8 universities, 9 Federal agencies, 3 State agencies, and 2 consulting firms.

Review Comments

During the period from March to December 1972, a total of 185 review comments concerning the E & E study were received by the Commission. A summary of the origin and categories of comments is shown in Appendix 9. Seven categories of comments concerning carrying capacity concepts as presented in the E & E study are recognized. Three categories show degrees of approval; three of disapproval; and one non-committal. Of those expressing a position, 148 or 88% approved and 21 or 12% were opposed.

In January 1973, the Commission asked its Urban and Rural Lands Committee to revise the E & E study in response to suggestions contained in the review comments. It was further reviewed by the 34 members of the committee and 38 special reviewers selected jointly by the Chairman and the Vice-Chairman of the Commission. Numerous revisions were made in the February draft and the result presented to Commission members in July 1973.

Acknowledgements

The efforts of a large number of interested persons were involved in making publication of the E & E study possible. Review and assistance in improving earlier drafts were provided by members of five other committees of the Pacific Northwest River Basins Commission: Economic Studies, Power Planning, Recreation, Fish and Wildlife, and Water Supply & Water Pollution Control. Members of the Economic Studies Committee were particularly helpful in pointing out the need for improving the economic aspects.

Thanks are extended to all the over 200 persons who reviewed and commented on earlier drafts.

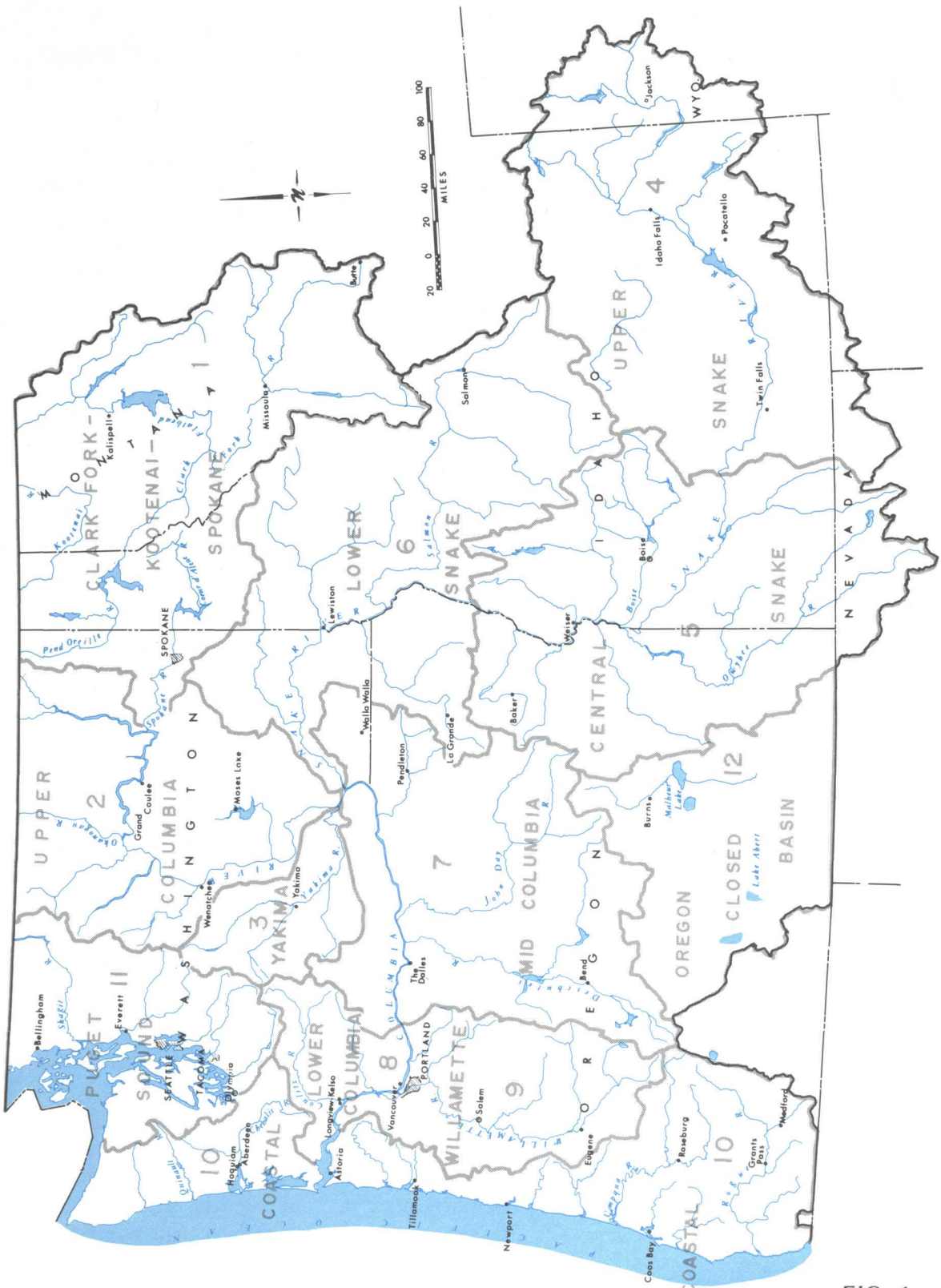
MILES
20 0 20 40 60 80 100
KOOTENAI-CLARK FORK 1
SPOKANE 1
UPPER COLUMBIA 2
YAKIMA 3
LOWER SNAKE 6
UPPER SNAKE 4
MIDDLE SNAKE 5
MID COLUMBIA 7
CENTRAL OREGON 12
CLOSED BASIN
PUGET SOUND 11
LOWER COLUMBIA 8
WILLAMETTE 9
COASTAL 10
COASTAL 10
Bellingham
Everett
SEATTLE
TACOMA
Olympia
Aberdeen
Hoquiam
Longview
Kelso
Astoria
Vancouver
PORTLAND
Salem
Eugene
Coos Bay
Roseburg
Grants Pass
Medford
Tillamook
Newport
The Dalles
Bend
Burns
Malheur Lake
Lake Abert
Pendleton
La Grande
Baker
Weiser
Boise
Salmon
Lewiston
Wallla Walla
Moses Lake
Wenatchee
Yakima
Grand Coulee
SPOKANE
Kalispell
Missoula
Butte
Idaho Falls
Pocatello
Twin Falls
Jackson
WYO
IDAHO
NEVADA
OREGON

FIG. 1

ORGANIZATIONAL CHART
Pacific Northwest River Basins Commission

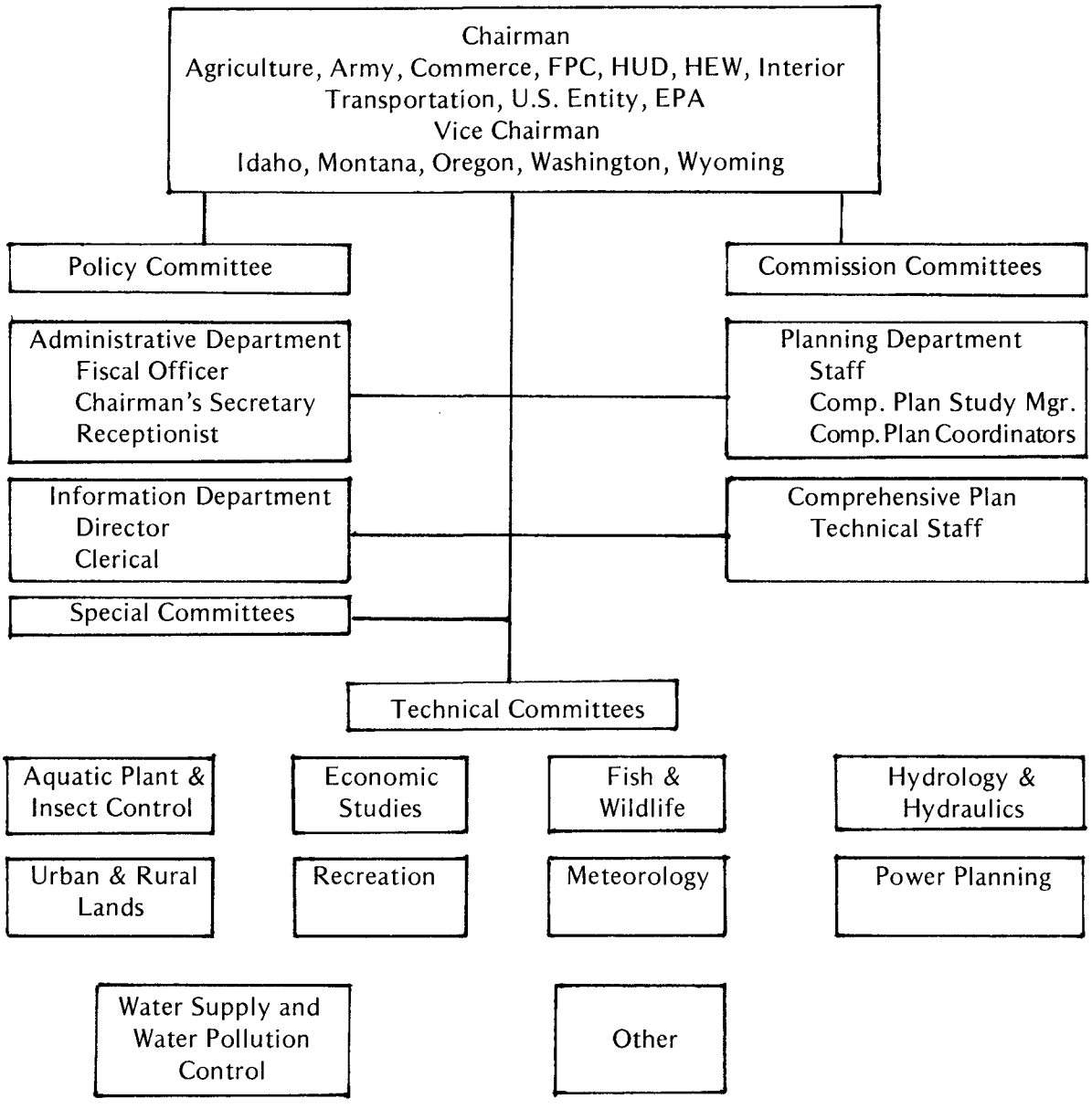

FIG. 2

CHAPTER I

AN EXPLANATION AND SYNOPSIS

Concern in the past about comprehensive long range goals for a region such as the Pacific Northwest has been minimal. Yet there is increasing concern about what is happening and may happen to the environment in the Northwest and elsewhere; and there appears to be an informal consensus that we should not only keep but improve the present high quality Northwest livability for ourselves, our children, and grandchildren.

Beyond that there is no consensus; there is little understanding of the long term effects that different rates and kinds of growth would have on the quality of life; there has been little concerted action toward adopting coordinated long range goals as a formal State or regional policy. There is no agreement on what mix of material goods and intangibles is needed for the highest attainable quality of life. Each person, each corporation, each governmental unit, each citizens' organization historically has pursued his or its own ends. The result has been unplanned, uncoordinated, and uncontrolled growth. This kind of growth historically has produced in the United States a high material standard of living. But it also is increasingly yielding undesirable environmental results and causing conflict.

If the desire of the people of the Northwest to protect and enhance the present high quality livability is sufficiently strong, they will succeed in adopting comprehensive long range goals and make the necessary legislative, organizational, financial, and operational commitments to implement them. But such long term commitments would require changing the patterns of the past. They would require unprecendented public involvement and farsighted planning, guiding, influencing, and directing growth and no-growth trends instead of merely reacting to what occurs on an ex post facto basis.

For the comprehensive long range planning that has occurred to date, the technique most frequently relied upon by planners and decision makers for identifying long range goals for population and economic growth has been projections of historical trends. These trend projections may be useful, particularly for the short term—ten years or so—but for the long term they appear to spell for the Northwest another Los Angeles or an East Coast megalopolis. To reach a different kind of long range goal, for example, a highest attainable quality of life goal would require a different planning base.

For over 30 years in the United States, and for a longer period in Europe, managers of renewable natural resources have been successfully applying, on a scientific basis, a land planning and management technique known as sustained yield, or carrying capacity. This approach has been used for forests, for farm land, for livestock grazing, for fish and wildlife, and for water yields. The long range goal is to obtain an annual or periodic output equal to the amount that can be produced during the same period without permanently impairing long term productivity, ecosystem integrity or the quality of the land, air, and waters and their environmental values. Recently the capacity of water bodies and airsheds to absorb pollutants is also being estimated.

It has been established that most, if not all, species of wild animals have instincts which usually tend to prevent overcrowding in their native habitat. They frequently thrive best at less than the maximum density which would be possible with the available food, shelter, etc. In other words, sustained carrying capacity estimates for different species of wildlife must recognize population density in addition to other constraints. There is growing evidence, but no conclusive proof and no consensus among experts, that similar principles apply to human society. Some of our urban centers, for example, are experiencing social unrest due in part to the "revolution of rising expectations" and in part to high density living. Some authorities contend there is a basic human need for natural open space and there may be an optimum population and acreage for individual urban areas. The carrying capacity in visitor days is being determined for parks, golf courses, hunting and fishing areas, wilderness areas, and similar recreation lands.

In the Pacific Northwest, both the bulk of the basic industries and the high quality scenery and outdoor amenities are dependent upon renewable natural resources—forests and grassland, mountains and valleys, rivers and lakes, agricultural land, urban and industrial land, seaports, ample high quality water, hydroelectric power sites, a continuous inflex of clean air off the Pacific Ocean, good climate, and over 50 percent of the region dedicated to open space. The industries based upon location such as those manufacturing transportation or electronic equipment or metals from imported ores find the Northwest a desirable location because of its renewable natural resources. The secondary industries, which are generated by the basic industries, are similarly oriented.

The only basic Northwest industry which the study considers to be based primarily upon non-renewable resources is mining. But fortunately the Northwest supply of its most important minerals such as stone, limestone, phosphate, copper, lead, zinc, and nickel should last from 50 years to indefinitely at present and projected rates of use. The Northwest presently is not self-sufficient in several vital minerals such as oil and gas, iron or aluminum ore. But this is no more of a disadvantage to the Northwest than it is to other mineral short regions of the nation.

With such a preponderance of the economy and the livability of the Northwest based upon renewable natural resources now and for the foreseeable future, would it be possible and desirable to determine carrying capacity for the Northwest in terms of population and production of goods and services per year (gross product)? Such an undertaking would require defining benchmark needs in terms of gross product per capita as well as intangibles per capita. Such an approach does offer promise as a way to achieve a "balance of nature" under the spaceship earth concept. It offers promise as an alternate to the historical trend technique. It might avoid some of the pitfalls and uncertainties of long range forecasting. But it would be no panacea.

The Urban and Rural Lands Committee decided to explore carrying capacity as a possible alternative means for identifying long range goals, needs, and demands, using the Pacific Northwest region for a preliminary test, and present the results to its parent organization, the Pacific Northwest River Basins Commission.

The steps employed are briefly outlined in the remainder of Chapter I. Those interested in more than a superficial understanding are urged to study carefully Chapters II through VI and all the appendices. All portions of the study are interrelated. The material in all chapters and all appendices contributes basic portions of the carrying capacity concept.

1. The need for an evaluation of natural resource sustained capability as the basis for establishing long range goals, needs, and demands is discussed. The rationale for exploring regional carrying capacity as a promising technique is explained—also the advantages of the Pacific Northwest as a region for testing the concept. Experiences in four areas in California that may provide useful examples for the Northwest are discussed.

2. The relative environmental stress or impact (use of natural resources and production of liquid, gaseous, and solid wastes) caused by humans and by their servant machines is examined. Also the benefits resulting from each increase in production per capita are considered. An average human unaided by energized machines is assumed to be able to produce annually $250 (1965 dollars) worth of goods and services. The number of servant machines per capita then equals:

$$\frac{\text{per capita share of gross product less } \$250}{\$250}$$

An additional factor is the amount of adverse impact caused by each servant machine that may be reduced by increasing the percentage of recycling and other forms of permanent pollution control. Such reduction in adverse impact would require improvements in technology and resource management to both reduce the amount of waste produced initially and to better dispose of the unavoidable residual.

3. A quality of life benchmark is defined in order to have a reference point for comparison with what is attainable for the Pacific Northwest. Using "Maslow's Hierarchy of Human Needs" and "The Marginal Utility of Goods and Amenities" for illustrative purposes, this is shown to be a precarious and ever-changing balance between intangibles and material items until an equilibrium may be reached, hopefully at a high quality of life level. Fifteen categories of living expenses are analyzed and benchmark standards and estimated costs stated for each. The total came to $7,500 (1965 dollars) in per capita income ($9,500 in per capita share of gross product). This compares to $2,785 in 1965 and trend projections of $13,200 income in 2020. When income is low, the basic necessities such as food and clothing are emphasized. As incomes rise, the emphasis shifts to more intangible items such as clean air and a pleasing landscape.

4. A technique is outlined for identifying the amount of pollution control and other means of reducing damage that would be necessary to meet the benchmark quality of life standards and also be economically and technologically feasible. The practical limit for such damage reduction, on an average, is assumed to be 80 percent. At this level, if the quality of water, land and air is at least as good as in 1965 (which is assumed to be at or near the benchmark standards on the average) the total gross regional product should not exceed $85 billion annually. This would amount to reducing the environmental stress caused by each

servant machine (but not each person) by 80 percent. It represents a balance or trade-off point at which the benefits to be derived from further production would be outweighed by the adverse effects of further pollution.

5. With an $85 billion gross product the number of people that could be sustained at $9,500 per year in per capita share of gross product (the benchmark standard of living) is about 9 million. This compares to 5.9 million in 1965 and about 6.6 million in 1972. Historical trend projections indicate the 9 million level will be reached about the year 2000 and reach 12 million by 2020. Efforts to influence such trends must begin in the 1970's if significant results are to be achieved by 2000. Alternate population levels using higher and lower gross product figures and relationships to the benchmark quality of life are considered.

6. The number of acres available, and potentially available, in each of nine categories of outdoor recreation land (open space) is determined. The carrying capacity and benchmark use standards are estimated for each category. Preliminary results are that with the most farsighted planning and dedication of land for intangible purposes it would be possible to sustain, at benchmark quality of life levels, 10 million residents, plus an average of 25 percent non-residents. Using the preliminary benchmark standards employed in the study, 10 million population then becomes the ultimate upper limit target for the Pacific Northwest. (With 10 million, the per capita share of gross regional product either should not exceed $8,650—about $850 short of the $9,500 benchmark, or the adverse impacts of economic activity must be reduced by more than 80%.)

7. The preliminary nature of the foregoing estimates is made clear. A ten-step procedure is outlined but only the first three steps are explored in the study. In case the carrying capacity technique outlined gains acceptance in the Pacific Northwest and elsewhere, a procedure is outlined (but discussed only briefly) for adopting interim goals, for providing missing or incomplete information, for making carrying capacity estimates for subregions, for revising regional estimates after subregional estimates have been made, and for making periodic and continuous adjustments based upon new information and progress in achieving long range regional goals.

Many of the methods and concepts employed in the study and reflected in the conclusions are new and untested. They are not fully supported by research findings or scientific multi-disciplinary studies of the future of human affairs in a particular geographic area. Many of the numbers used are first approximations and intended to be illustrative rather than the final product. Considerably more intensive effort and involvement by many diverse interests will be essential before the carrying capacity concept can be successfully applied to the entire population and level of economic activity in a nation, a region, or a portion thereof. The purpose of this study is to demonstrate that the carrying capacity approach is a promising method for identifying attainable long range goals. Carrying capacity is not a historical trend projection, although projections may be used in some of the subsidiary determinations. Neither is it a prediction nor a forecast of what the population or economic activity will be.

Planners and decision makers at regional, state, subregional, and local government

levels now have the opportunity to thoroughly test and improve the carrying capacity concept. It is a suggested addition to the four alternative techniques for identifying goals now in use. It may eventually be widely accepted and applied and strongly influence growth and no-growth trends in the direction of agreed upon long range goals. Several years of public consideration is anticipated before there could be a public consensus that would define the desired long range goals and provide solid and sustained support toward their attainment.

Those who may not be satisfied with either the basic concepts or the specifics of this pioneering effort as applied to the Pacific Northwest are challenged to suggest either specific improvements or a better conceptual approach. Perhaps the study will stimulate professional workers elsewhere to improve the approach offered and make similar efforts for other regions or for the entire nation.

The study recognizes that, although the Pacific Northwest is a reasonably viable geographic and economic unit, it is and will continue to be a part of the United States and of the world. By guiding and encouraging growth and no-growth trends it may be possible for the Northwest to maintain temporarily (perhaps for 20 years or so) a higher quality of life than other parts of the United States as far as scenery, air and water quality, outdoor recreation, wildlife, open space, etc., are concerned. This higher quality could be maintained in the long run only if other portions of the United States were making substantial progress toward attaining similar high quality livability goals.

CHAPTER II

THE CARRYING CAPACITY APPROACH—ONE ALTERNATIVE

Are the current efforts toward attaining a high quality environment on a collision course with population growth and economic growth? Economists and ecologists currently are debating the issue. In an address to the World Affairs Council on March 29, 1972, Russell Train, Chairman of the United States Council on Environmental Quality, called for a full public debate on national growth goals. Economic growth objectives have dominated United States policy since colonial days. Only within the last decade has appreciable attention been devoted to human ecology—the relationship between human beings and their physical environment (including biological components). Many "ecologists" or "environmentalists" are concerned that the United States is approaching, or in some areas, may have exceeded, the finite limits of land, water, and air resources to sustain additional population and industrial growth.

A groundswell of interest and action is developing to protect and improve the quality of our future environment in the Pacific Northwest, as well as the rest of the nation. Northwesterners view conditions in their region as among the best in the nation. The outdoor environment is relatively unspoiled. Few leave except for economic reasons. Historically there has been a substantial net in-migration. But if effective counter-measures are not taken, increases in population and industrialization may eventually result in drastic degradation of the quality of the outdoor environment.

The Office of Business Economics, U.S. Department of Commerce, and Economic Research Service, U.S. Department of Agriculture (OBERS), 1967 projections to the year 2020 include a change in population for the Northwest region from 5.9 million in 1965 to 12.7 million (216%); and in per capita annual personal income, in constant 1965 dollars, from $2,785 in 1965 to $13,189 (474%). In per capita share of gross regional product the change would be from $3,520 to $16,700. Such increases would result in 10.2 times the production of goods and services that existed in 1965 or from $20.4 billion to $208 billion in constant 1965 dollars. The 1971 projections based upon 1967 data show population in 2020 as 11.97 million and per capita income as $13,181, in 1965 dollars. These are shown graphically in Figure 3.

These projections of economic activity are included in Appendix VI, "Economic Base and Projections," of the Columbia-North Pacific Comprehensive Framework Study being conducted by the Pacific Northwest River Basins Commission. Until March 1973 the long range projections were accepted as the primary basis for identification of future "needs" and provided constraints for other portions of the Commission's long range framework plan, such as the construction of dams and reservoirs by Federal and State agencies.[1]

---

[1] At its 36th meeting on March 22, 1973, the Commission adopted the policy that henceforth "OBERS projections be utilized as a base and not as a planning objective." This action means that the Commission may consider guidelines other than OBERS projections in completing its comprehensive joint plan. The 1972 version of OBERS explicitly explains that "the projections are in no sense a goal or quota. They carry no connotation as to desirability or undesirability." (Vol. 1, p.7)

Historical trend economic projections, including some consideration of individual resource capability, frequently have been accepted by planners and decision makers as goals and are used to forecast the long range "needs" and "demands" for other national and local programs such as public lands and resources, transportation, energy supply, housing, health and education. The Battelle Memorial Institute and the Bonneville Power Administration have used such methods for projecting Pacific Northwest long range growth in population, employment, and income. This type of economic projection has proven to be a reasonably accurate forecast during the past 50 years and no other system for identifying goals has been readily available. However, it frequently ignores natural resource supply constraints, assumes unlimited growth, and fails to quantify either the combined capacity of all Northwest natural resources to sustain growth or the effect that the projected growth and economic development would have on the livability, the congestion, the air and water pollution, and the natural or the intangible values.

Would the result be use in excess of renewal capacity of the natural resources?

Would the capacity of our natural systems to assimilate man-made waste be overwhelmed?

Would Northwest conditions in the year 2000 be comparable to conditions in 1972 in the Los Angeles area or the East Coast megalopolis?

Would people have a higher material standard of living but enjoy it less?

For a philosophical background in our attempt to answer such basic questions this study leans only slightly on either the pure ecologists or the economists, whether classical or contemporary.

Instead it utilizes contemporary multidisciplinary efforts that attempt to gain a balanced perspective of the two, such as:

Tragedy of the Commons - Garrett Hardin, 1968.
Resources and Man-Preston Cloud, Ed., National Academy of Sciences, 1969.
Design With Nature - Ian McHarg, 1969.
Man's Impact on the Global Environment - Report of SCEP, sponsored by the Massachusetts Institute of Technology, 1970.
Population, Resources, Environment - Paul R. Ehrlich & Anne H. Ehrlich, 1970.
The Closing Circle - Barry Commoner, 1971.
Environment, Power, and Society - Howard T. Odum, 1971.
A Blueprint for Survival - in *The Ecologist,* January 1972.
Report of the Commission on Population and the American Future- March 1972.
Ecolibrium - Athelstan Spilhaus in *Science*, February 1972.
The Doomsday Syndrome - John Maddox, 1972.
Economic Growth and Environmental Decay - David W. Seckler & Paul W. Barkley, 1972.
Population, Resources, and the Environment - Ronald G. Ridker, Ed., Vol. III of Research Reports prepared for the Commission on Population Growth and the American Future, 1972.

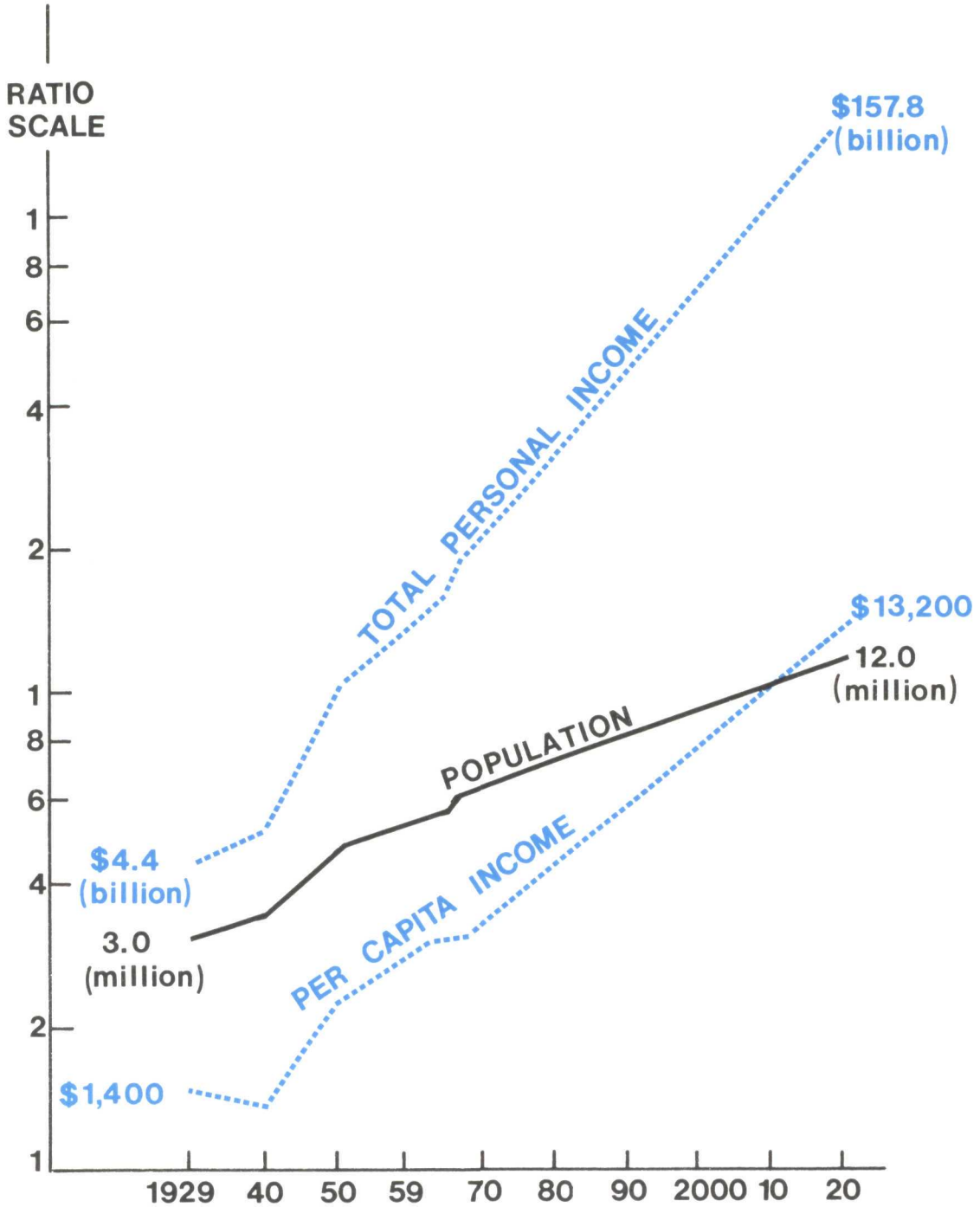

FIG. 3 PACIFIC NORTHWEST GROWTH IN TOTAL PERSONAL INCOME, INCOME PER CAPITA, AND POPULATION FROM 1929 to 1967, WITH PROJECTIONS TO 2020

Source: Office of Business Economics, U.S. Department of Commerce; and Economic Research Service, U.S. Department of Agriculture (OBERS), 1967 base year (1965 dollars).

Growth Limitations

Any function monotonically increasing in a positive non-fractional geometric progression will approach an infinite amount. This is commonly referred to as exponential growth. Since land and other natural resources are finite and since population and gross regional product increase in a geometric or a variable series, a limit will be reached if growth continues. One natural law that is as immutable as the law of gravity is that nothing physical on this planet can expand forever. Based upon these principles the assumptions are made that:

(a) It is physically impossible for either the gross regional product or the population to expand forever;

(b) A state of equilibrium must be reached eventually, the unknowns are when and how; and

(c) At some point in time, further increases in population and gross regional product begin reducing the overall quality of life.

Has the Pacific Northwest already passed the optimum levels? If not, what levels can be sustained?

The foregoing questions and assumptions are controversial. They challenge the "American ethic"—the doctrine of "manifest destiny"—of Keynesian economics—that growth is progress and progress is good—that the "invisible guiding hand" of the market place automatically will produce the optimum mix of material and intangible benefits and safeguard common property resources such as the air, waterbodies, and large ecological systems. There has been relatively little scientific effort devoted to studying such basic issues.[2] Public concern frequently is in the form of recrimination and rhetoric, or attempts to treat some of the more obvious superficial symptoms, or attempts to divert attention from and postpone action on the real issues. Reluctance to tackle the basic issues directly may be because it is contrary to the growth drive that has been United States gospel since 1776 and has in fact motivated much of mankind since prehistoric times. But changes in our way of life and the quality of living are increasing rapidly. Since 1950 the real output of goods and services in the United States has exceeded the total for the previous 330 years. What we do now, or fail to do, fixes future patterns of life. We can no longer afford to approach the future haphazardly. The choice is whether to plan for and guide future changes or be engulfed by them.

During the first six decades of the 20th Century, primary attention in this nation has been focused piecemeal upon the short range uncoordinated planning, promotion, and development of individual components of the economy and the environment such as transportation, industrial production, agricultural production, forest production, energy supplies, water development, health, education, recreation, fish and wildlife, and wilderness preservation. The promotion, development and preservation goals have been further fragmented into small individual units by mission oriented

---

[2] See Chapter VIII, "Population Growth, and Resources," The First Annual Report of the Council on Environmental Quality, August 1970.

private concerns, cities, counties, etc. Our decisions frequently have been based upon the perspective of individual disciplines with few cross ties to weigh the overall relevance of separate partial analyses. Little effort has been devoted to assessing the long range cumulative effects of all these activities upon the livability of everyone in an entire state, multi-state region, or the nation as a whole. Little effort has been devoted to influencing optimum long range growth trends.

Re-orienting Basic Assumptions about Growth

Until very recently orthodox economists here treated the environmental costs of economic growth as "externalities" far removed from their primary concerns. Most of the assumptions to date by economists and other planners have been that the future will be an extension of the past; that population increases and industrial growth inevitably will continue at an exponential rate and the proper course of action is to supply the highways, electrical power, water, urban expansion, etc., needed to accommodate this growth; that plans are needed only to organize the inevitable; that any problems which result from the growth will be solved by using science and technology—by substituting artificial human-control systems for natural ecosystems.

There is a rapidly developing differing view[3] that:

(a) Many of today's problems are a result of successes as defined in yesterday's terms;

(b) An extension of the past is not the right prescription for the future;

(c) The primary planning goals for this nation should be altered—with high quality livability as the major long term objective (including a major improvement in the economic position of many of our citizens) and economic development shaped around this overriding determinant;

(d) Science and technology, if oriented toward harmony with nature, can, within limits, increase both the quality and the reliability of nature's carrying capacity and assist in reaching the highest attainable quality of life goals; in fact science and technology appear to be indispensable instruments for such a purpose;

(e) Through social and political action it is possible to encourage, modify, or block growth and development trends so that they are compatible with those long range goals which are supported by a popular consensus.

---

[3] An example is the July 17, 1970, report to the President by the National Goals Research Staff entitled "Toward Balanced Growth: Quantity with Quality." Another example is the March 1970 report of the California Select Committee on Environmental Quality, which recommends an amendment to the State Constitution providing an "Environmental Bill of Rights." A third is a sketch version of a plan for the future of California to the year 2000 developed by the organization, *California Tomorrow,* San Francisco, Summer 1972.

As Professor Elbert Bowden* observes, "Once he ventures into the realm of concepts to which meaningful numerical values cannot be assigned, the regional economist loses the opportunity to apply much of his specialized methodology. He is stripped of his aura of mysticism and compelled to communicate with policy-makers and administrators in their own language. Suddenly he is faced with the need to demonstrate his understanding of the real world workings of a broad range of economic theory. It is easy to understand the desire to shy away from such demanding circumstances."

* Professor of Economics, State University of New York, Fredonia in *Land Economics Journal,* May 1971, pp. 113-121.

Unquestionably, the attainment of the present United States material standard of living coupled with a high level of personal freedom and leisure time has been a magnificent achievement—the envy of much of the world. But there were unforeseen and costly consequences too. Now there are new challenges. The foresight exercised in today's planning decisions and actions (or lack of actions) will determine the quality of life (including material standard of living) available for our children and grandchildren. Land, water, and air resources must be recognized as inseparable components of single life support system—not as independent reservoirs for both raw materials and waste disposal to be appropriated and exploited at will. Some way must be found to balance and harmonize both economic and ecologic goals while maintaining our principles of democracy and personal freedom.

> *Efficiency economics doesn't measure basic values which our society holds as its goals, such as preservation of human life, social justice, freedom, opportunity for individual expression and a chance to live a quality life in a quality environment . . . Blind adherence to the standards and methodology of efficiency economics has provided us with a set of decision-making tools which, in some respects, are poor tools.*
>
> *Senator Henry M. Jackson*
> *April 7, 1969*

There are similarities between the present concern over livability goals and the aspirations of Thomas Jefferson, other founding fathers and 19th century leaders, for a pastoral society of peace and contentment. As this nation's industrialization and westward expansion were occurring, only the most astute grasped the contradiction between the kind of environment Americans said they wanted and the kind they were actually creating.[4]

Alternative Goals

If the desire of the people is to control their own destiny and build a future which differs from an extension of the past it will be necessary to decide upon long range goals and tailor long range plans and action programs to best fit those goals. We face both a challenge and an opportunity that will test to the maximum our ingenuity and our perseverance. We must reject both the complacent and the despairing view of the future. Changes in many of our traditional procedures and priorities would be required. Among them is the practice of adopting goals for future growth in population and economic activity based primarily upon the projection of historical trends.

Alternative one—arbitrarily adopt a "no growth" policy.

Alternative two—make every effort to accelerate growth.

Alternative three—combine several scenarios of pollution, natural beauty, living space, and other environmental quality trends with several alternate economic projections

---

[4] Naysmith, J.K., *"Canada North - Man and the Land"*, Ottawa, Department of Indian and Northern Affairs, 1971, Catalogue No.R 72-6770.

to present a better balanced picture (quality of life indices) of the possible futures. Systems science simulation and modeling sometimes are used in preparing scenarios.

Alternative four—is geared to resource capability on a sustained basis (carrying capacity.) It could be a steady state scenario under alternative three. The carrying capacity alternative appears to have considerable potential for identifying sustainable balances between ecology and the economy and is the major topic of this study. Carrying capacity is neither a historical trend projection nor a prediction. It is an optional long range goal.

Carrying Capacity as a Goal

Carrying capacity is an ancient principle in man's relationship to the land. It is an established scientific method for the management of renewable resources such as agricultural land, forests, watersheds, and wildlife, but has not previously been applied to the entire economy and environment of a region or a nation. However, multiple use, sustained yield laws do govern the management of renewable resources on certain Federal lands under the jurisdiction of the Forest Service and the Bureau of Land Management. It was the way of life for mankind prior to the industrial and technological age beginning in the early 1800's—the age when man began the exponential exploitation of non-renewable resources. It represents capacity under "steady state" or "dynamic equilibrium" conditions (with moderate oscillations in population and gross product but with continuous invention to increase choices, improve quality, and provide greater diversity).[5]

The remainder of this paper presents, within the limits of available information, the basic features of a prototype system for identifying different combinations of population levels, economic activity levels, and intangible value levels that are possible for the Pacific Northwest—an approach that identifies both the limits of basic natural resources of a region to support future growth and the desirable and undesirable consequences of various levels of growth. It is intended as a constructive alternative to the projection of historical trends system which sometimes may have been misinterpreted as being a forecast and frequently may have been adopted by default as a long range goal. The purpose is not to set forth explicitly the means of attaining the long range goals that may be selected. This is a vital next step after the goal setting process but is beyond the scope of this particular effort.

It is important to recognize, however, that increasing mobility will accompany increased affluence—that both the economy and the ecology of the Northwest, the nation, and the world are interrelated. In the United States, people and industry will increasingly tend to migrate toward locations such as the Pacific Northwest, which at present has a generous endowment of natural outdoor values and an attractive balance between development and nondevelopment, until crowding has reduced quality enough to make the gradient disappear. It would be very difficult to counteract this trend. The material standard of living in the Northwest is approximately the national average and the chances of major

---

[5] In its 1972 report, "National Parks for the Future," commissioned by the National Parks Centennial Commission, the Conservation Foundation recommends that three types of carrying capacity be determined for each national park: physical, ecological, and psychological.

improvements in the Northwest's relative position are not promising. However, the Northwest region may be enough of a geographic and economic entity that it would be possible to maintain the present advantage for certain intangible values (scenery, air and water quality, outdoor recreation, wildlife, etc.), at least temporarily—perhaps for twenty years. During that period greater understanding of carrying capacity concepts may result in national, regional, and state policy changes. Certainly the task would require zeroing in on long range root causes rather than short range superficial symptoms.

Some authorities disagree; they contend that efforts to guide the amount and destination of in-migration or intraregional distribution of population and industry would prove futile at least in the long run. Even if these authorities are correct, the intent of this study is still not without purpose. It could help to maintain the Northwest natural outdoor environment at high quality levels for a longer period than less fortunate regions. Also it should assist in development of techniques which, when applied nationally, may suggest a maximum population level for the United States, as well as for each of its major regions, and help to identify pollution control and land allocation levels required to maintain environmental quality. The Northwest could become an example for other parts of the nation. But whether or not measures to guide regional growth and no-growth trends could be effective over long periods, population, productivity, and protection of intangible values eventually must be brought into a sustainable state of balance for the nation.

The *California Tomorrow Plan,* Revised Edition, Summer 1972, presents one version of how a regional goal of the best attainable balance between ecology and the economy might be implemented. Another approach is outlined in the study program "Environmental Resource Management System" (ERMS), for San Diego County prepared at California State Polytechnic College, Pomona, December 1971.

The 1972 Resources for the Future publication "To Live on Earth" includes an environmental matrix listing environmental problmes and suggesting possible economic, institutional, and technological methods for correction.

Sufficient information is available about the Northwest inventory of natural resources to begin a study of the potential of these resources to support future industrial growth. Much less information is available concerning the specifics for the often nebulous term "environmental quality" and how various levels of "development" and various levels of pollution control of liquid, solid, and gaseous "wastes" will affect the livability. Research of this kind is in its infancy. Some of the needed basic information is missing or incomplete. Consequently, this study represents a pioneering effort; hopefully it will stimulate others to continue and expand the approach.[6]

Many competent authorities believe that many cities and nations of the world are more densely populated than would be desirable in the long run. The judgment of the National Academy of Sciences in its 1969 publication "Resources and Man," is that "a

---

[6] The President's Commission on Population Growth and the American Future (P.L. 91-213) completed in March 1972, a report to the President outlining "the various means . . . by which our nation can achieve a population level properly suited for its environmental, natural resources, and other needs." Senator Packwood of Oregon was a member of the Commission.

human population (for the world) less than the present one would offer the best hope for comfortable living for our descendants, long duration for the species and the preservation of environmental quality."

A summary of some of the current views of prominent authorities about "overcrowding" is presented in Appendix 2.

A. Population-Industry Relationships

Frequently natural resource and environmental quality problems are equated with population. But human numbers are only one part of the equation. The other part is the goods and services (gross product) man produces with energy applied to machines.[7] This energy may be derived from domestic animals, from hydro power, from burning wood or fossil fuels, from nuclear or direct solar sources. For a nation or a large region the consumption of natural resources and the potential detrimental impact on the environment, as well as the material benefits, is assumed to increase roughly in proportion to the increase in the gross product. This relationship appears to be approximately correct for the overall average. However, there are variations in the potential impact from basic industries as compared to secondary industries, for example, or between individual basic industries; also the relationship can be modified substantially by reusing "waste" materials and by other forms of pollution control.

Economists Paul Barkley of Washington State University and David Seckler of Colorado State in their 1972 book "Economic Growth and Environmental Decay" discuss the relationship in detail. A summation in their final chapter reads as follows:

> *Economists have underestimated the problem in believing that the detrimental effects of economic growth on the environment are simply by-products, spillovers, or external costs of growth. This leaves the impression that if society uses its conventional powers over economic policy to "internalize" these externalities, the process of economic growth can continue ad infinitum in a pleasant environmental setting. This is a wholly misleading belief. Environmental decay is an integral part of the economic growth process. There is no conceivable way to produce, use, and eventually dispose of economic commodities without creating some degree of environmental decay. The longer economic growth continues, the more severe will be environmental decay. It is a trade-off. The trade-off is acceptable to a point, but beyond that point it can no longer be tolerated. To believe that society can always have both is simply a reaffirmation of the ancient fallacy of 'something for nothing.' . . .*

---

[7] Jean Mayer, "It's the Rich Doing the Crowding," Washington D.C. *Post*, July 20, 1969. (Also Congressional Record, 10/13/69, H 9431.)

The stationary state offers the bounty of both man and nature. The great dread of the early Classical (economists) may be the only hope of the Moderns.[8]

Gross product also is assumed to be roughly in proportion to energy consumption. The relationship between income, gross product, and energy use, on an annual per capita basis for selected nations, is shown in Figures 4, 5, and 6. Although the relationship has been roughly correct in the past fifty years it is not necessarily inviolate for all time. But at present there is insufficient evidence upon which to base an assumption of a change. On a national basis there was a slight downward trend in the use of energy per unit of GNP between 1950 and 1968, but since then it has been rising. Theoretically, there could be a substantial reduction in the per capita use of energy, perhaps as much as 25% from only one approach—conservation measures such as better insulation in all heated or cooled buildings. But the added insulation would require more capital investment and probably would not be installed unless the unit costs of energy increase substantially. Inertia and lack of sufficient economic incentive would similarly militate against the full use of other potential energy conservation measures.

In "Environment, Power and Society," Howard Odum uses energy equivalents, energy diagraming, and energy flow as the common denominator for simplifying and analyzing the great problems of population, natural resources, pollution, food supply, economic growth, and eco-system stability.

For convenience the per capita share of gross national product in 1965 dollars is used as the measurement of goods and services produced. In 1967 the situation in one affluent nation and one "underdeveloped" nation was as shown in Table 1.

Table 1[1] Comparison of Per Capita Consumption

	United States	India
Per Capita Share GNP in 1967	$3,490	$88
Energy Equivalent Required (tons of coal)	12	0.25
Steel (pounds per capita per year)	1,300	30

[1] "The Next Ninety Years," proceedings of a conference sponsored by the Office for Industrial Associates at the California Institute of Technology (1967), Harrison Brown, Professor of Geochemistry.

It appears clear that the total stress or impact per capita upon the environment is much greater in industrialized countries such as the United States than in "underdeveloped" countries such as India. The latter uses far less land and natural resources, far less goods and services, and causes far less pollution on a per capita basis. In other words, in India most of the environmental stress is caused directly by the human population. In the United States, which has only moderate population density, the bulk of the environmental stress results from economic activity.[9]

[8] "Economic Growth and Environmental Decay," Seckler and Barkley, 1972. Hart, Brace, Jovanovich, Inc., 757 Third Ave., New York, N. Y., 10017.

[9] In an article entitled "Overpopulated America" in *The New Republic*, January 10, 1970, Prof. Wayne Davis, Univ. of Ky., defines an "Indian equivalent" as the average number of Indian citizens that cause the same detrimental effect upon the land's ability to support human life as the average American. His figure, which he considers very conservative, is 25. The British authors of "A Blueprint for Survival" (1972) use "Indian equivalents" in a similar manner.

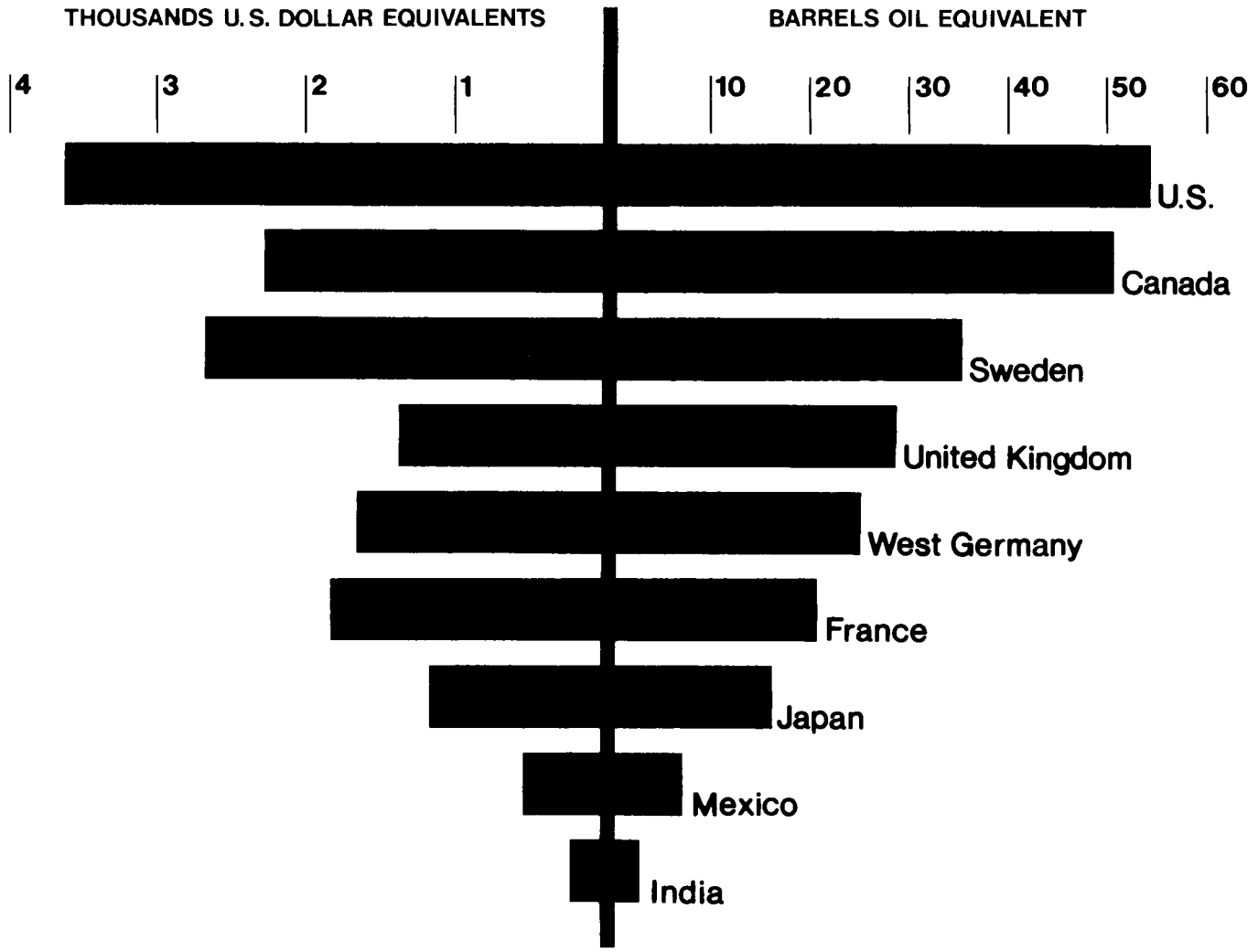

FIG. 4 ANNUAL PER CAPITA INCOME & ENERGY CONSUMPTION

Source: Based upon 1968 data. Standard Oil Company of California Bulletin, 1970.

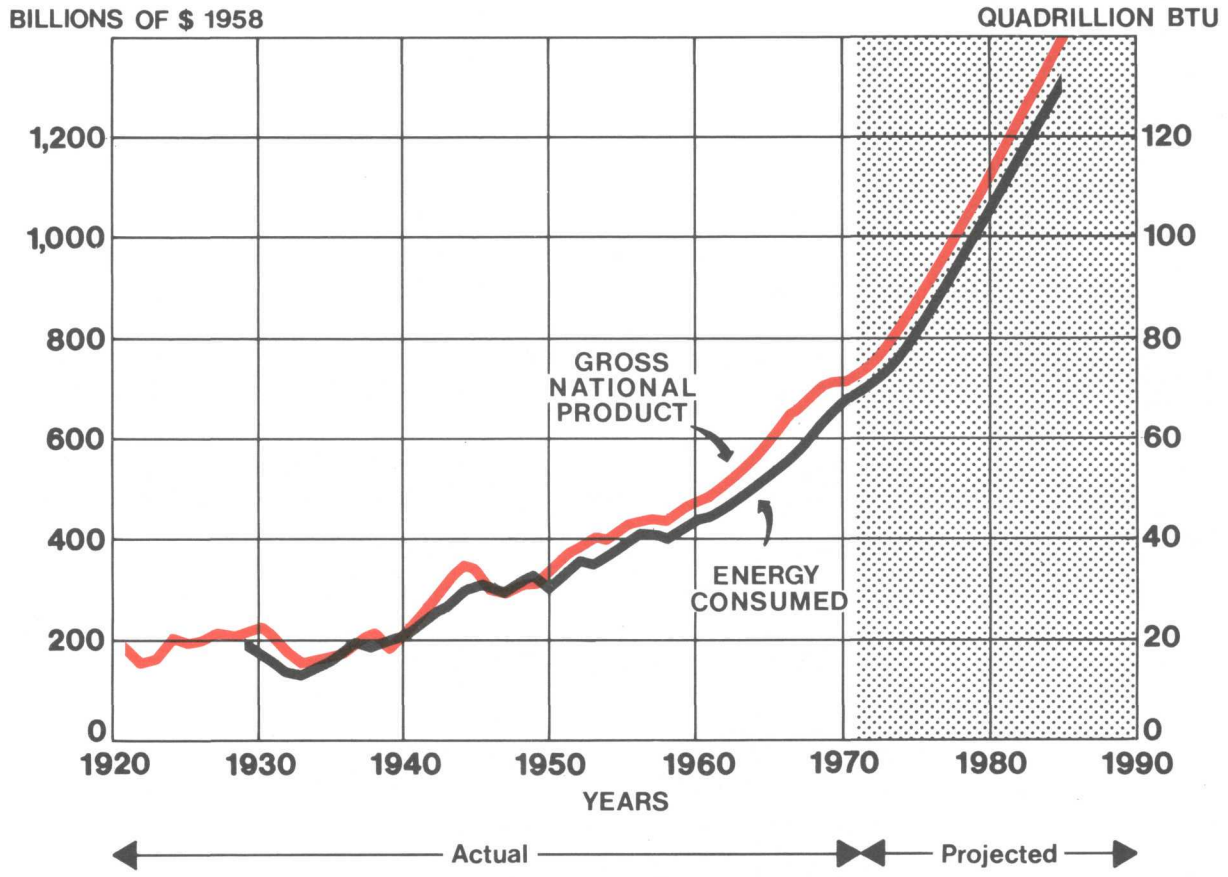

FIG. 5 U.S. ENERGY USE AND GROSS NATIONAL PRODUCT ARE CLOSELY RELATED (About one million BTU's are expended in producing one 1958 dollar in GNP.)

Source: Office of Oil and Gas, Department of the Interior, March 1971.

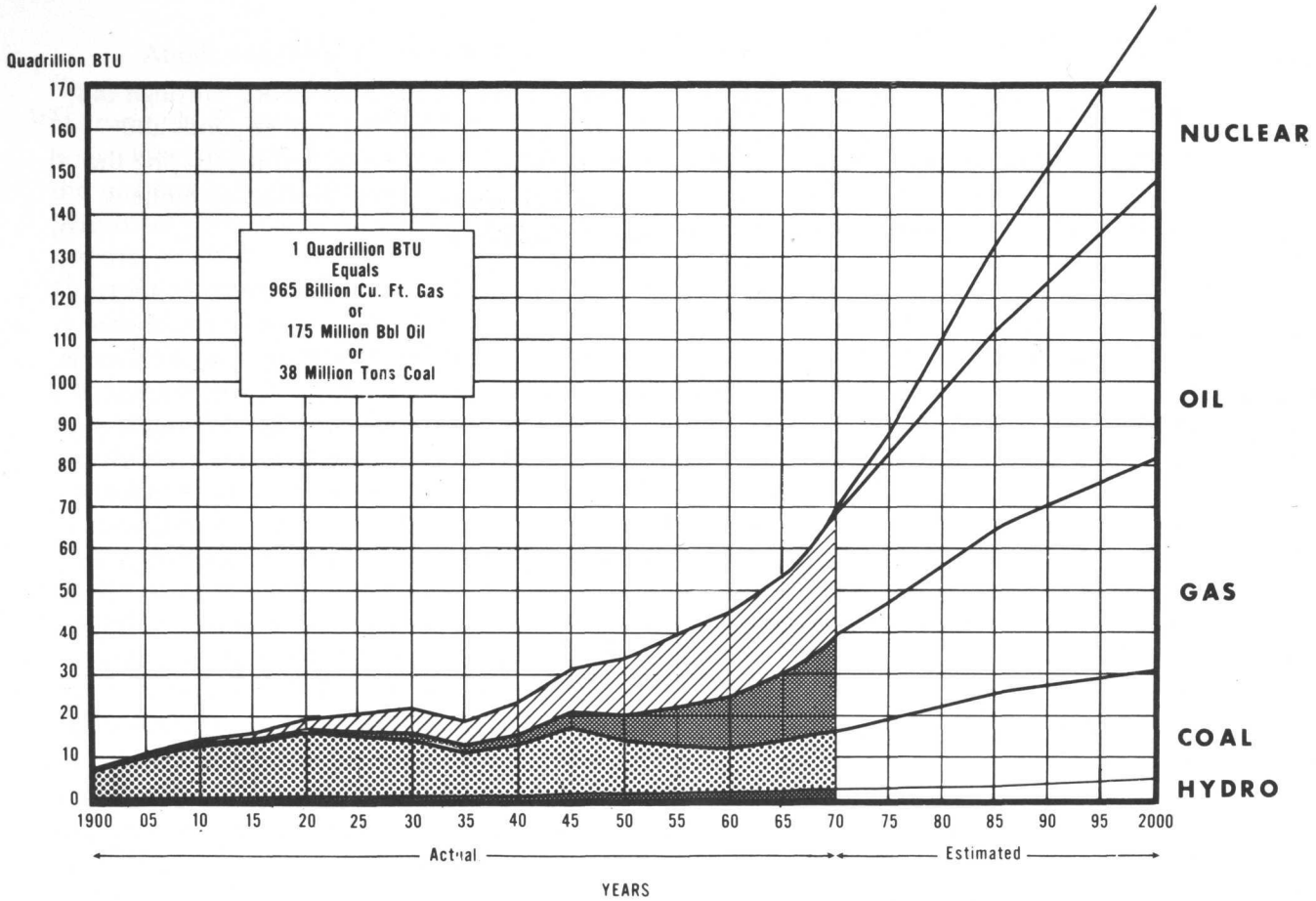

FIG. 6 U.S. ENERGY CONSUMPTION IN THE 20th CENTURY

Source: Office of Oil and Gas, Department of the Interior, March 1971.

Servant Machines

A portion of the gross product is produced by unassisted human labor. Through the use of energy and technology the capacity of an average individual to produce goods and services has multiplied as a nation becomes more industrialized. One way of illustrating the relationship is to assign a portion of the per capita production of gross product to humans and the remainder to their "servant machines." [10]

An exact dollar figure representing what an average person could produce without modern powered equipment (exclusive of domestic animals) probably cannot be established. In 1870, according to the Historical Statistics of the United States, U.S. Bureau of the Census, the per capita share of GNP in the United States was $440, in 1965 dollars. Earlier statistics are not available. The 1870 figure probably was above the base due to the very favorable natural resource supply situation and rudimentary industrialization. On the other hand the $88 figure for India in 1967 appears low for use as a worldwide base. Much of the economy of India, and other undeveloped nations, is barter and subsistence, not through established markets and therefore not priced in national statistics. A figure of $250 per year appears to be a good compromise and more realistic. It would approximate 4 kilowatt years of electrical energy or the energy equivalent resulting from the combustion of about 1,700 pounds of coal. Lacking a more refined comparison, let us make this assumption. This would mean that in the United States in 1967, the average person had 13 "servant machines" ($3,490/$250 less 1) at his disposal—each "servant" producing as many beneficial outputs and using as much resources and space and causing as much pollution in the process as its owner. This is without considering the amount of pollution control; such information is not available for the United States or other nations. In comparison, a citizen of Sweden had 8.5 servant machines; Canada, 8; West Germany, 5.6; Japan, 2.8; Russia, 2.3; and mainland China or India, only a fraction. [11]

Other information showing the density of population in 1967 and 1980 and industrial output in 1970 and 1980 in representative nations of the world is depicted in Appendix 3.

In 2020, with increasing affluence, the number of "servant machines" is projected to increase to 61 per person in the United States. However, the end point of uncontrolled expansion is total destruction. Sooner or later we must achieve a sustainable balance between the rate we use and exploit basic resources and the capacity of the environment to support such use and abuse. As the British technologist, Dr. Dennis Gabor, expresses it:

> *Exponential curves grow to infinity only in mathematics. In the physical world, they either turn around and saturate or they break down catastrophically.*

---

[10] As an illustration, Admiral Hyman Rickover in 1957 stated that machines supply the average American family with the equivalent of 33 household servants (8 per person in a family of 4). Government Executive, September 1972.

[11] It is emphasized that the "servant machine" is only a convenient illustration and is not a central issue in developing the carrying capacity concept.

About one-third of the hydroelectric potential of the United States is in the Pacific Northwest. As a result, Northwest citizens and industries now enjoy about twice the average per capita U. S. consumption of electric power at about one-half the average cost per kilowatt hour. Even though most of the large hydro sites have been developed, the coordination of thermal power plants (fossil fuel, fission, fusion, solar, geothermal) with hydro plants will permit continuation of relatively low cost power. In addition, hydro, nuclear, solar, or geothermal plants avoid air pollution of the type usually associated with fossil fuel power plants. However, they have other inherent problems and limitations.

There is sufficient water for foreseeable needs for irrigation, industries, cities, navigation, fish and wildlife, recreation, water quality control, etc. Shortages east of the Cascade Mountains potentially can be relieved by pumping water either from the Columbia River or from west side surpluses. Water quality probably is the best in the nation. There are about two million acres of water surface and 10,150 miles of free flowing rivers.

The Northwest has outstanding scenery and outdoor recreation opportunities in great variety in the form of mountains and valleys, geologic formations, forests and other vegetation, wildlife, and historic sites. There are, for example, 23 established wilderness areas totaling 6 million acres, 8,700 miles of designated scenic highways, and 3.4 million acres in 17 units of the National Park System. The bulk of the remaining 92 million acres of Federal land in the Northwest is administered by the Forest Service and the Bureau of Land Management. There are 9.5 million acres in State, county, and municipal ownership making a total of 60 percent public ownership. These public lands are well distributed throughout the region. The bulk of them are uninhabited, rough, and mountainous, and will remain in public ownership to provide weekend and vacation recreation opportunities and open space for all Northwesterners for the foreseeable future.

Climate is a major factor in attracting people to or repelling them from an area. There are many variations in the climate of different Northwest localities. Prevailing westerly winds off the Pacific Ocean both moderate the climate and provide a continuous influx of clean air. West of the Cascade Mountains the summers are characterized by moderate temperatures, little rainfall, and mostly sunshine. Winters are mild but wet. East of the Cascades summers are warm to hot, sunny and dry to very dry; winters are cool to cold, moist to dry, partially sunny, and sometimes windy. Average precipitation in the region is 28 inches with extremes ranging from 200 inches in the Olympic Mountains to about 6 inches in the dryest portion of the Snake River plains. The growing season varies from an average maximum of 220 days along the coast and in the Puget Sound-Willamette Valley areas to an average minimum of 100 days in the Oregon High Desert and many mountain ranges. Climate also provides a major constraint upon that portion of the Northwest suitable for habitation under conditions of optimum livability. For example, west of the Cascades there are about 2 million acres where annual precipitation is less than 48 inches and the growing season exceeds 160 days. The same acreage comprises both the best agricultural land and the best land for settlement and development.

As discussed in Chapter IV and Appendix 6, the Pacific Northwest has a sufficient supply of both renewable and non-renewable resources to permit further, but limited, orderly

It is possible that, if environmental quality is to be maintained, the total number of humans that could be sustained in a given region would tend to decrease as individual affluence (servant machines) increases; or conversely, the greater the number of people at a given time the fewer there would be who could "live like kings." As Garrett Hardin in "Tragedy of the Commons" points out, Jeremy Bentham's 19th Century principle, "The greatest good to the greatest number in the long run" is a mathematical and biological impossibility. The two variables cannot be maximized simultaneously.

The relationship between population, economic activity, and the quality of the outdoor environment can be modified by mitigating the damages caused by resource use, by improving the management and the technology so there is less damage in the first place, and by recycling or otherwise neutralizing the polluting effects of solid, liquid, and gaseous "wastes"—up to a point. The technological and economic limit for recycling and other resource damage control varies widely and will change with time. At present it falls between 10 and 90 percent for most items. Also, there is an absolute limit to the amount and rate of the residual waste that can be assimilated by nature's processes—the airshed over an urban area, for example.

If significant changes are to be achieved by the year 2000, action must be initiated during the '70's. For example, if the United States should continue the fertility rate of 2.1 children per woman (the maintenance level) first achieved in 1972, the population would not stabilize until the year 2037, at about 275 million (assuming no net in-migration.) [12]

B. Basic Pacific Northwest Advantages [13]

As a region for testing the carrying capacity concept in relationship to quality of life, the Pacific Northwest has many intrinsic advantages. One of the most significant is the fact that at a time when the public is becoming acutely aware of the ecologic consequences of uncontrolled growth, the Pacific Northwest region as a whole is relatively uncongested. In 1965 two of the subregions, Puget Sound and Willamette Valley, with 8.7 percent of the land area, had a population of 3.2 million or nearly 60 percent of the regional total. Puget Sound averaged 4-1/2 acres per capita and the Willamette Valley 6-1/3. For the remainder of the region the average was 60 acres per capita. The Northwest's high quality environment—land, water and air, is largely intact. Thus, there may be sufficient opportunity, time, and public will to guide both the future growth and distribution of Northwest population and industry in a manner that maintains high quality livability.

Another advantage is 550 miles of Pacific Ocean frontage and excellent seaports, particularly in Puget Sound and along the Columbia River.

---

[12] *Business Week*, October 24, 1970, p. 103. Also, *Economic Report of the President*, 1971, P. 110.

[13] Appendix II, The Region, Columbia-North Pacific Framework Study.

growth and economic development, without degrading the environment. Fortunately, the bulk of that natural resource potential is renewable. The amount of growth that can be accommodated will depend to a considerable extent upon sophisticated long range land use planning and management and the recycling or otherwise neutralizing the polluting effects of what is presently considered to be liquid, gaseous, and solid wastes. An explanation of both the technology available for recycling and the present use of the process may be found in Appendix 7.

C. The California Example

For a variety of reasons population and industrial growth in the neighboring California region since 1850 has been at a far more rapid and sustained rate than in the Pacific Northwest. In 1965 the California region with a population of 18.1 million, a gross regional product of $69 billion, a per capita share of gross regional product of $3,800, and a total area of 104 million acres, had 5.75 acres and 14 servant machines per person equivalent. (For comparison with the Pacific Northwest, see Table 6.) [14] The OBERS level C projections, 1967 data base, are that the population of the California region in 2020 will reach 54 million. This is projected to require 26 times as much electrical energy.

The possibility that the combination of population increases and economic growth already may be reducing the quality of life in California finds support in a 1971 poll by the Field Research Corporation. It reveals that nearly one-third of the persons interviewed desired to move out of the state.

In 1970 the stage of development of the Pacific Northwest in some ways approximates that of the California region 30 years ago. For example, in 1940 the population of the California region was 7 million. Consequently, citizens of the Pacific Northwest have an unexcelled opportunity to learn from both the failures and successes of the California experience—to gain knowledge of how to reach a sustainable accommodation between the twin goals of both growth and development and preservation and enhancement of natural values.

> *. . . there is usually a fundamental conflict between the short-term and long-term consequences of a policy change. A policy which produces improvement in the short run, within five to ten years, is usually one which degrades the system in the long run, beyond ten years. Likewise, those policies and programs which produce long-run improvement may initially depress the behavior of the system. This is especially treacherous. The short run is more visible and more compelling. It speaks loudly for immediate attention. But a series of actions all aimed at short-run improvement can eventually burden a system with long-run depressants so severe that even heroic short-run measures no longer suffice. Many of the problems which we face today are the eventual result of short-run measures taken as long as two or three decades ago.*
>
> *J. W. Forrester* [15]
> *January 1971*

---

[14] Appendix IV, Economics, The California Region Comprehensive Framework Plan, Preliminary Field Draft.

[15] J. W. Forrester, "Counterintuitive Behavior of Social Systems," in *Toward Global Equilibrium: Collected Papers*, Wright-Allen Press, 1973.

Examples of conditions that have developed and actions that have been taken in California which may provide clues as to how to proceed in the Northwest are discussed in Appendix 8. Four areas are selected—Santa Clara County, the Los Angeles area, Napa County, and the San Francisco Bay area.

D. Differences in Needs for Growth and Development and for Preservation of Intangible Values within the Northwest Region

The Pacific Northwest is a land of contrasts. It consists of the Columbia River drainage in the United States plus coastal streams of Oregon and Washington. Physiographically it may be divided into eight provinces: (1) the Coast Ranges; (2) the Puget Sound-Willamette Valley trough; (3) the Cascade Range; (4) the Columbia Plateau in East Central Washington and North Central Oregon; (5) the Blue Mountains in Northeastern Oregon and Southeastern Washington; (6) the Oregon Closed Basin; (7) the Snake River Plateau of Southern Idaho; and (8) portions of the west slopes of the northern Rocky Mountains in Montana, Wyoming, Idaho, and Washington.

About 60 percent of the region's population in 1965 was concentrated on 8.7 percent of the regional land area in the Puget Sound-Willamette Valley trough and the trend toward further urbanization is continuing. The 1970 census reveals that the total population of the Pacific Northwest increased about 17 percent since 1960. However, nearly all of the increase occurred in urban areas. For example, the Idaho population increased from 667,000 to 712,600 or 6.8 percent. But over 40 percent of that growth occurred in the Boise area. In Oregon, 21 of the 36 counties (all rural— mostly east of the Cascades) either were static or lost population. A similar pattern occurred in Washington.

It has been suggested that, given the present state of knowledge, further growth of large urban centers should be discouraged; and that such growth be re-directed toward new urban centers from 25,000 to 250,000 in population. [16] Key incentives to settlement in new growth centers probably would include attractive job openings, ample education and health facilities, cultural opportunities, attractive natural resources for intangible purposes, and a clean and stimulating environment.

> *I am convinced that we are reaching, if we have not indeed passed, the outer limits of our political and managerial capability to make big cities pleasant, safe, and tolerably healthy places to live. . .I do not regard it as a temporary phenomenon, nor is it peculiar to the United States. . .I say big cities because I think there is both subjective evidence and theoretical logic*

---

[16] Berry, J. S., and Schwind, Paul, "Cities of the Future," *Proceedings of the Fourth Annual Urban Policy Conference*, October 26-28, 1967 (Institute of Public Affairs, University of Iowa), pp. 25-55; Jerome P. Picard, "Is Dispersal the Answer to Urban Overgrowth," *Urban Land Magazine*, January 1970; Advisory Committee on Inter-governmental Relations, "Urban and Rural America: Policies for Future Growth," a 1968 report; and "A Blueprint for Survival," *The Ecologist*, January 1972, pp. 14-17.

that says the problems of administering cities of over a half million mount rapidly as the size increases.

Dr. Robert W. Lamson [17]
April 15, 1971

Even though all Northwest states experienced a gain in population between 1960 and 1970, one lost more by out-migration than it gained by in-migration. The State of Washington had a net in-migration of 24,000; Oregon 160,000; Idaho a net out-migration of 41,700; western Montana remained nearly in balance.

The contrast in average per capita incomes also is very evident. In 1965 the average Northwest income was $2,785. But it varied from $2,325 in the Upper Snake subregion to $3,160 in Puget Sound.

Understandably then, the residents of subregions with the lightest concentrations of population and lowest per capita incomes evidence considerable concern with growth and development goals. However, residents of all subregions are beginning to evidence more concern about quality of life; the concern appears to be most insistent in the Willamette Valley-Puget Sound subregions.

[17] Dr. Robert W. Lamson, National Science Foundation, before the Commission on Population Growth and the American Future, April 15, 1971.

CHAPTER III

A QUALITY OF LIFE BENCHMARK

A. General Characteristics

One important early step in the process of identifying alternative "acceptable" long range goals for a region is to determine the various combinations of economic affluence and environmental quality that are attainable and relate these combinations to an "optimum," or to some standard that is a temporary substitute for an optimum. In other words a technique is needed to measure the trade-offs between material quantity and intangible quality. There is no universal agreement concerning what would constitute an optimum quality of life in a particular geographic area for humans. To a degree such perceptions are culturally oriented. However, probably a majority in the United States would agree that in an ideal environment the basic needs of every citizen would be satisfied and he or she would have full opportunity for personal fulfillment and have the assurance that his or her children and grandchildren, ad infinitum, would have the same opportunities. Personal fulfillment ordinarily means reasonable opportunity to develop one's innate potential for creativity and constructive effort for the long term benefit of both himself or herself and society as a whole.

In an optimum environment there would be ample challenge, diversity, and inspiration to satisfy a wide range of interests, cultures, and life styles. There would also be moderate stress and competition—not an effortless society on the other hand or a ruthless, overdemanding one on the other. Every human would be needed to fill a useful role in society, and would be respected as an individual. Everyone would have personal freedom and freedom of choice to pursue his own goals, whether they be economic, moral, social, or esthetic. No one would be forced to reside where he either suffered from lack of human companionship or felt hemmed in by too many people.

There has been little scientific effort devoted to systematically identifying the elements that comprise an optimum quality of life. Yet if the people are to guide their future destiny, the ultimate goals must be described in both comprehensive and understandable terms. One way to come to grips with such a complicated problem, in the absence of adequate information about all its aspects, is to propose a basic conceptual framework and subject it to review, revision, improvement, and refinement. The description of a quality of life benchmark in this subchapter represents such a pioneering effort. Both the material elements and the intangible elements are essential to the realization of the desired quality of life, but one of the greatest potential threats this nation faces is that the intangible values will be irretrievably destroyed during the pursuit of short term, material values. Indeed, the tragic evidence of such myopia is already apparent to too many parts of this nation.

In an effort to improve their lot the people of different cultures throughout the world historically have placed initial emphasis upon acquiring the basic necessities. Frequently this required sufficient concentrations of population, and knowledge of science and technology to make more efficient use of available energy, automation, and mass production. Similar economies of scale usually have been necessary to maintain facilities for security, education, health,

government, and entertainment.

The experience in the modern "developed" nations has been that as soon as per capita income exceeds the amount needed to satisfy the most essential portions of basic and immediate material needs for existence such as food, clothing, housing, security, health, and transportation, the average person's (and nation's) interest and emphasis shifts to longer range and more intangible items (and our most perishable amenities) such as education, recreation, clean air, clean water, quietness, open space, personal elbow room, variety, and stimulation, cultural opportunities, attractive design and landscaping, natural and man-made scenic beauty, and wilderness. Usually such amenities require a substantial number of servant machines per capita, including those used to control the adverse effects of production. Because of the increasing affluence and rising expectations of the average person, it appears that in the next century there will be sharply increasing interest in cultural and esthetic pursuits and other quality aspects of the environment in the United States—an interest that was very low key during the past century—all concentrating on a land, water, and air resource base that is finite.

Other nations may be similarly motivated. Those struggling for an economic toehold have little energy left for planning long range improvements; or as John Galbraith expresses it, "The natural priorities of a society proceed from getting the goods to getting the surroundings in which they can be enjoyed." The United States now has the economic capability to invest heavily in measures designed to enhance the well-being of future generations.[18]

To further aid in understanding the philosophical approach to the best attainable balance in the long run between ecology and the economy (or intangibles and material goods) three points of view are discussed briefly: one psychological, one economic, and one environmental. All three points of view are reflected in the more specific approaches to the problem subsequently employed in this study. Although the three approaches start from entirely different bases they converge toward common solutions to the problems of balancing ecology and the economy.

The Hierarchy Approach

Some psychologists who have been studying human motivation in the United States refer to the relationship as the "hierarchy of human needs." Those needs are depicted as a triangle consisting of five compartments with physiological needs at the base and self-fulfillment needs at the apex. The arrangement indicates that a need at one level tends to be the primary motivation after the most essential, but not necessarily all, of the needs at the lower levels have been satisfied (Fig. 7). There are many individual exceptions, and the need categories tend to blend and intermingle but on the average, after the physiological and security needs are met, energy is available for satisfying more intangible needs, assisting others, and anticipating the needs of future generations. However, without the necessary motivation, the energy may not be used for such purposes.

---

[18] Galbraith, John, "Economics and the Quality of Life," 45 *Science* (1964)

5. Sense of accomplishment and achievement of full capability; acceptance of new challenges; broadening of horizons of interest; self actualization

4. Achievement of independence, self-esteem, deserved respect of peers, recognition, confidence

3. Sense of belonging to a group and acceptance by other people, love and affection

2. Protection from physical harm, assurance of continuing income and employment, protection of home (including land and other natural resources, which provide the basis for quality of life over the long term

1. Air, water, food, shelter, clothing, sleep, reproduction of the species, identity, stimulation, etc.

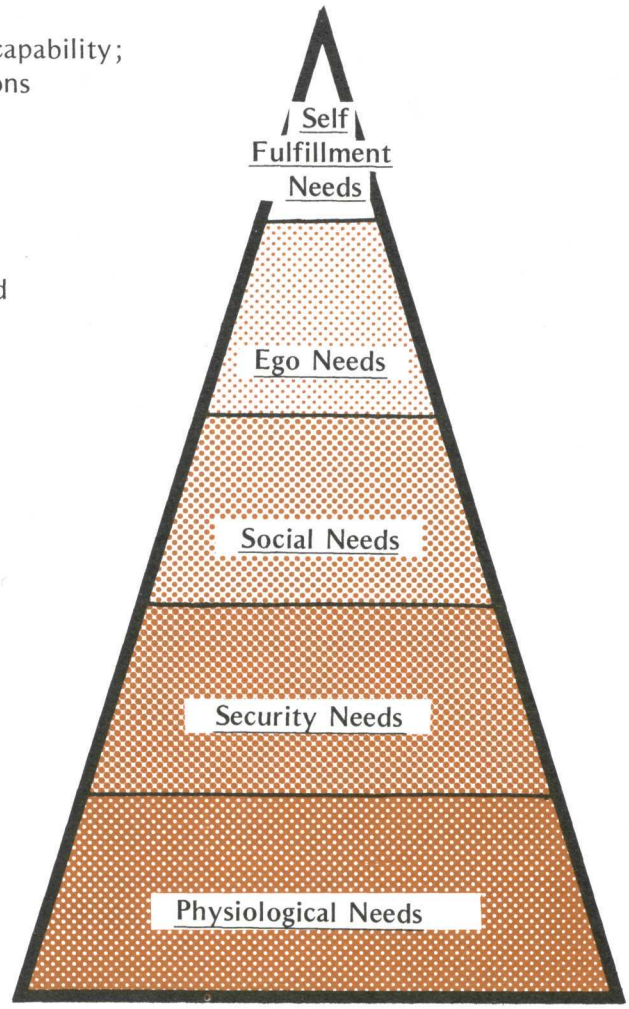

FIG. 7 THE HIERARCHY OF HUMAN NEEDS

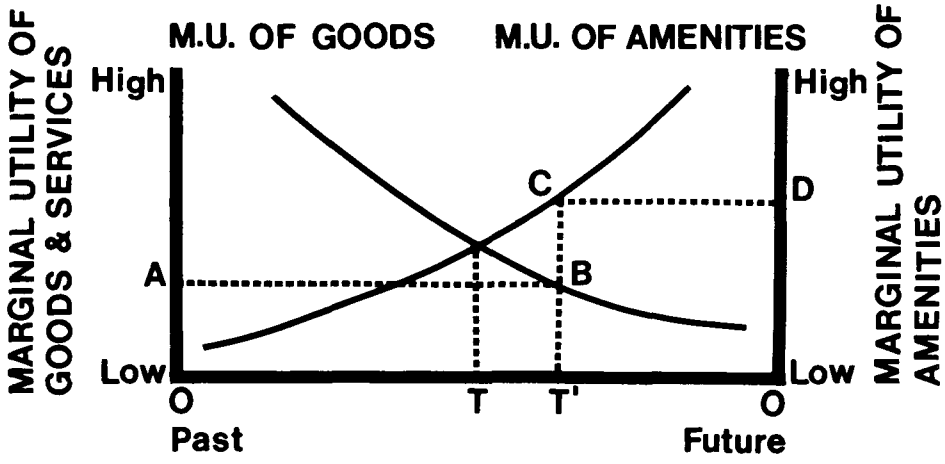

FIG. 8 MARGINAL UTILITY OF GOODS AND AMENITIES

The hierarchy theory is that with each step upward (or downward) a person's, or a nation's short range goals and priorities change. The long range hazard that some can clearly foresee, and others do not yet perceive, is that a nation's efforts to satisfy the basic material needs for an ever increasing population can foreclose the opportunities for eventually satisfying the intangible self-fulfillment needs essential for an optimum quality of life.

The hierarchy of needs theory may be useful as an illustration but the reader should be aware that it has limitations; it is not universally accepted. Also the emphasis on the various steps varies with different cultures, between nations, and within an individual nation.

The Marginal Utility Approach

Many economists (and others) would distrust the parsing of human behavior into compartments, like the five of the "hierarchy of human needs." But economists would find the hierarchy's working consistent with their theory of human behavior: at higher levels of goods, further goods would go to less basic uses. Goods consumption rises more slowly than income. The value of more of something (its"marginal utility") falls while the relative value of substitutes rises as one gets ever more of the first thing. Obtaining more goods makes additional goods less valuable and further amenities more valuable.

Economic analysis leads to the hierarchy's conclusion that, as goods-incomes rise ever higher, people and societies will find still more goods inferior to more amenities (intangibles).[20]

If obtaining more goods entails giving up some amenities or future values, optimal balance of goods and amentities could be approximated. It depends upon people's values or "tastes," social and economic institutions, the distribution of incomes, and the technical possibilities for producing goods and amenities; the optimum is that level of incomes and amenities where the value of an increment of goods foregone just equals the value of the amenities preserved or created. For example, if a living tree is worth more than an extra page of supermarket ads, a net social loss occurs if the tree is converted to newsprint.

As Barkley and Seckler explain it in "Economic Growth and Environmental Decay:"

> *In the developed countries goods and services have accumulated in upper middle class homes to such an extent that the marginal utility of "things" has surely dropped. At the same time, fresh air, clean water, wilderness, and quiet (things often called "amenities") have one by one become more scarce, more dear.*

The curves in Fig. 8 show the decreasing marginal utility (MU) of these accumulating goods over time and the corresponding increase in the marginal utility of amenities.

---

[20] Discussed in Chapter IV C.

Under such conditions the wisdom of producing more and more goods should be questioned since, by moving into the future (past time period T in the figure) the added utility of goods and services would be lower than the marginal utility of the amenities that had to be sacrificed in order to produce the goods. At point T^1, amenities with marginal values of OD have been sacrificed to obtain goods with marginal utility of OA. The difference (BC) indicates the net loss.

A change in social values would shift the balance; e.g., a work-and-consumption-oriented society would settle for more goods and fewer amenities than a more leisure-oriented one with the same incomes, institutions, and technology. An increase in the level of incomes generally would shift the balance away from goods-consumption and vice versa. Making the distribution of income more equal would shift the balance towards goods-consumption; distributing a million dollars among poor people would bring a greater demand for goods and place greater pressure on the environment than a similar distribution to the rich.

Institutions matter, for they determine how decisions are made and the consequent trade-offs among goods and amenities. Does the man who wants a wood fire have access to other than the Charter oak, and can a paper mill dump sludge "free" into the people's river? Institutions can be rearranged to change the possible alternatives and trade-offs for higher goods-incomes, more amenity, or perhaps a more equitable distribution of incomes.

Technology's role is obvious, for a change to more efficient processes could yield more goods-incomes and more amenities for the same resources. Similarly, a better design could accommodate people in the same space with less sense of crowding or more people with no more crowding.

Even if all present activities were as equitable and efficient as possible (optimal), the problem of excessive growth might remain. Those who decide whether to add to growth weigh their own particular consequences, but not necessarily all the consequences. If they incur and consider only the unfavorable effects, growth will be less than optimal from society's point of view. If only the immediate benefits are considered, the converse will occur–excessive growth. For some institutional changes that might offset this, see Chapter VI C.

The Environmental Approach

The policy of Congress as expressed in the National Environmental Policy Act (P.L. 91-190) is ". . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

Environmental quality, as conceived by the Council on Environmental Quality, encompasses the entire spectrum of man's surroundings–the social, economic, and commercial as well as the intangible–the necessities and the luxuries–the rural and the urban, the air, water, and land. In short, the attainment of high quality environment requires the harmonizing of the net effect of all man's activities with the basic natural laws that govern all life on earth. Confusion over the term "environmental quality" arises because of current emphasis upon elements that have been neglected in the past such as clean air, clean water, and scenic beauty.

The wise use and development of natural resources and a healthy economy comprise a large and fundamental part of a high quality environment. But to achieve a more stable balance, the past over-emphasis on single purpose short term exploitation of resources for their material values must be corrected and more attention paid to long term planning and to the intangible values.

Successful implementation of carrying capacity concepts for the Northwest region would appear to fulfill most, if not all, of the basic principles, precepts, and requirements of the National Environmental Policy Act. It would involve incorporating these principles and precepts in day to day decisions and operating procedures by public agencies, private concerns, and individual citizens. As these principles and precepts are adopted there could be a corresponding reduction in emphasis upon the environmental impact statements that many today consider an onerous burden and an obstacle to progress.

B. Specific Elements

In order to satisfy all levels of human needs, the use of basic natural resources is necessary. A generally understood and readily available common denominator which measures both the way natural resources are used and progress made toward quality of life goals[21] is an apportionment of average per capita income. Despite its deficiencies, money is a remarkably reliable and versatile measure of human reaction. (In the distant future it is possible that energy will become the ultimate currency.)

After a brief study of benchmark quality of life standards for 15 different categories of living expenses, an average per capita annual income of $7,500 in constant 1965 dollars ($30,000 gross for a family of four) is used to represent the amount needed to satisfy benchmark quality of life standards now or in the foreseeable future. This would be comparable to adopting the 1972 upper middle income standards as an average, but it does not deal specifically with income distribution. Individual incomes are expected to vary substantially from the $7,500 average, comparable to variations from the average in 1972. The distribution of the $7,500 is shown in Table 2. Standards used for each of the 15 categories are explained in Appendix 4. A possible method of showing the relationship between the hierarchy of human needs and apportionment of average per capita income under the benchmark quality of life standards is depicted in Appendix 5. A preliminary estimate is that about 28 percent of the $7,500 would be for physiological needs; 21 percent for security needs; 18 percent for social needs; 15 percent for ego needs; and 18 percent for self-fulfillment needs. The benchmark standards are pioneering examples. They are not based upon exhaustive or conclusive analysis; no such detailed studies are available.

In contrast, OBERS projects that the $7,500 average will be reached about the year 2000 and advance to $13,200 by the year 2020. The $7,500 in per capita income compares to about $9,500 in per capita share of gross regional product. The latter is about 2.7 times the national average in 1967. It appears attainable only by increasing the productive efficiency or

[21] As used in this study, "quality of life" comprises both material goods (standard of living) and intangible values (amenities).

output of the average worker by 170 percent above the 1967 level. This would require major improvements in science and technology and continued availability of energy at acceptable prices. It would require an increase in servant machines per person from 13 in 1965 to 37. The per capita income in the Pacific Northwest is now, and is assumed to continue, at approximately the same level as for the remainder of the United States.

But Dr. Jay Forrester of M.I.T., in his 1971 book "World Dynamics," states that it is highly improbable that such a worldwide level of individual affluence ever will be approached. It is uncertain whether the $7,500 level (in constant dollars) will be reached even in the United States. According to the standards used by Dr. Forrester, the overall quality of life on a world-wide average basis, peaked during the 1960's and a decline is underway. However, by most any method of measurement, the quality of life in the Pacific Northwest is much better than the global average, and it potentially can be improved even further if sufficient foresight is exercised.

TABLE 2 - AVERAGE APPORTIONMENT OF INCOME

Expenditure Category	Average Per Capita[1] for a member of Family of 4 in 1960		Average Per Capita under Benchmark Standards, in 1965 Dollars	
	Dollars	Percentage	Dollars Required	Percentage of $7,500
1. Food	402	18.33	960	12.8
2. Clothing	138	6.30	450	6.0
3. Housing	437	19.93	1,200	16.0
4. Transportation	290	13.20	700	9.34
5. Health	235	10.74	320	4.26
6. Education	149	6.81	380	5.07
7. Clean Air	—	[2]	150	2.0
8. Clean Water	—	[2]	160	2.13
9. Solid Waste Disposal	—	[2]	110	1.47
10. Quiet	—	[2]	160	2.13
11. Attractive Surroundings	—	[2]	130	1.73
12. Recreation	72	3.31	400	5.33
13. Open Space	—	[2]	320	4.26
14. Savings, Contributions, Insurance, & Misc.	164	7.48	560	7.48
15. Federal, State, & Local Government[3]	305	13.90	1,500	20.0
TOTAL	$2,192	100%	$7,500[4]	100%

1 U.S. Department of Labor, Bureau of Labor Statistics, Survey of Consumer Expenditures, Western Region.

2 Not segregated by BLS in 1960—probably included under other items.

3 Includes government expenditures for items other than the 14 categories listed in Table 4. Government expenditures assumed to be 60% Federal, 20% State, 20% local. Information concerning government expenditures from the Federal Budget-1960, and State of Washington, Office of Program Planning and Fiscal Management.

4 Equivalent to $9,500 in per capita share of gross product.

CHAPTER IV

CAPACITY OF PACIFIC NORTHWEST TO SUSTAIN POPULATION AND GROSS PRODUCT FOR BOTH MATERIAL PURPOSES AND INTANGIBLE PURPOSES

In Chapter II it was demonstrated that in the United States energy use since 1920 has been and is expected to continue to be proportional to gross national product. However, each increase in the GNP results in a comparable increase in demand upon the basic natural resources which support all economic activity. In addition, unless mitigated by permanent type pollution control, increases in regional or national GNP result in more pollution. (See definition in glossary.)

One commonly expressed societal goal is to increase average per capita income. Another goal is to maintain (or regain) pure air and water, ample open space, a pleasant landscape, and all human developments in harmony with the natural setting (avoid pollution). However, as was pointed out in Chapter II, both goals cannot be maximized. But a balance can be achieved. What trade-offs between the two variables are attainable in the Pacific Northwest?

The Northwest natural resources (forests, agricultural and grasslands, minerals, fish and wildlife, abundant high quality water, climate, relatively clean air, mountains and valleys, ample open space, seaports, relatively low cost electric power, and land suitable for industry, cities, transportation facilities, etc.) provide the foundation now, and for the foreseeable future, for sustaining the population and the industry for both material purposes and intangible purposes. We must learn how to balance these two purposes in such a fashion that the natural resource base can be maintained for 100 years and more, and perhaps even improved.

There are several techniques, some extremely complicated, that might be used to apply the carrying capacity concept to the Pacific Northwest (including techniques to measure the trade-offs). But during the initial exploratory period this study attempts to concentrate on the major principles and critical factors, present them in a direct skeletal fashion, and illustrate with first approximation numbers as follows.

1. Assess the GRP and the amount of pollution in the base year (1965). Then determine the relationship between additional GRP and additional pollution with different levels of pollution control. Also assess potential constraints.

2. Assess the utilzation of natural resources in the base year (1965) to generate the GRP and their potential for production in the future on a carrying capacity basis. Assess potential constraints.

3. Assess the utilization of natural resources in the base year (1965) for intangible purposes and their potential for the future on a carrying capacity basis. Assess potential constraints.

4. Within carrying capacity constraints identify the optional goals available for future growth in the Pacific Northwest in terms of various combinations of population and per capita GRP and the relationship of each combination to (a) overall pollution levels in 1965, and (b) the quality of life benchmarks identified in Chapter III. (Item 4 will be discussed in Chapter V.)

A. Capacity for Gross Product with Different Levels of Pollution Control

> *Principle 6 The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems. The just struggle of the peoples of all countries against pollution should be supported.*[22]

In 1965, our data base year, the Pacific Northwest GRP was about $20.5 billion but the average annual per capita income ($2,785) was only 37% of the benchmark standard ($7,500) identified in Chapter III. There was localized air pollution, water pollution, visual pollution, noise pollution, and land misuse. However, for the Northwest as a whole, natural systems were assimilating practically all of the waste produced and, as observed in Chapter II, the Northwest was relatively uncongested and its high quality natural environment was largely intact.

As used in this study, the term "pollution" includes all kinds of activities by man which cause land spoliation, water quality degradation, air quality degradation, or harmful noise.[23]

The adverse effects of pollution (environmental impact) can, within limits, be mitigated by increasing the percentage of pollution control. Measures that are available for such a purpose, all of which would require substantial increases in the application of science and technology, include (a) using raw materials more efficiently and otherwise redesigning processes, machines, etc., to reduce pollution at its source; (b) shift of emphasis to goods and services with inherently less pollution problems (changing the composition of the GRP); (c) cleaning up effluents and emissions before releasing them; (d) recycling "wastes"; and (e) deliberately planning and implementing all development so that it is in harmony with natural eco-systems.

The exact amount of artificial pollution control in the Pacific Northwest in 1965 is unknown. However, as explained in Appendix 7, there was some. A rough estimate of the amount of recycling (mostly solid wastes) is 10%. Other forms of artificial pollution control did exist (primary and in some cases secondary sewage treatment plants, and rudimentary erosion control are two examples), but there was relatively little control of noise or of emissions to the atmosphere. The total artificial pollution control, in addition to recycling, was

---

[22] From "Declaration of Principles," adopted by the United Nations Conference on the Human Environment, Stockholm, June 5-16, 1972.

[23] See Appendix I, "Glossary of Terms," for complete definition.

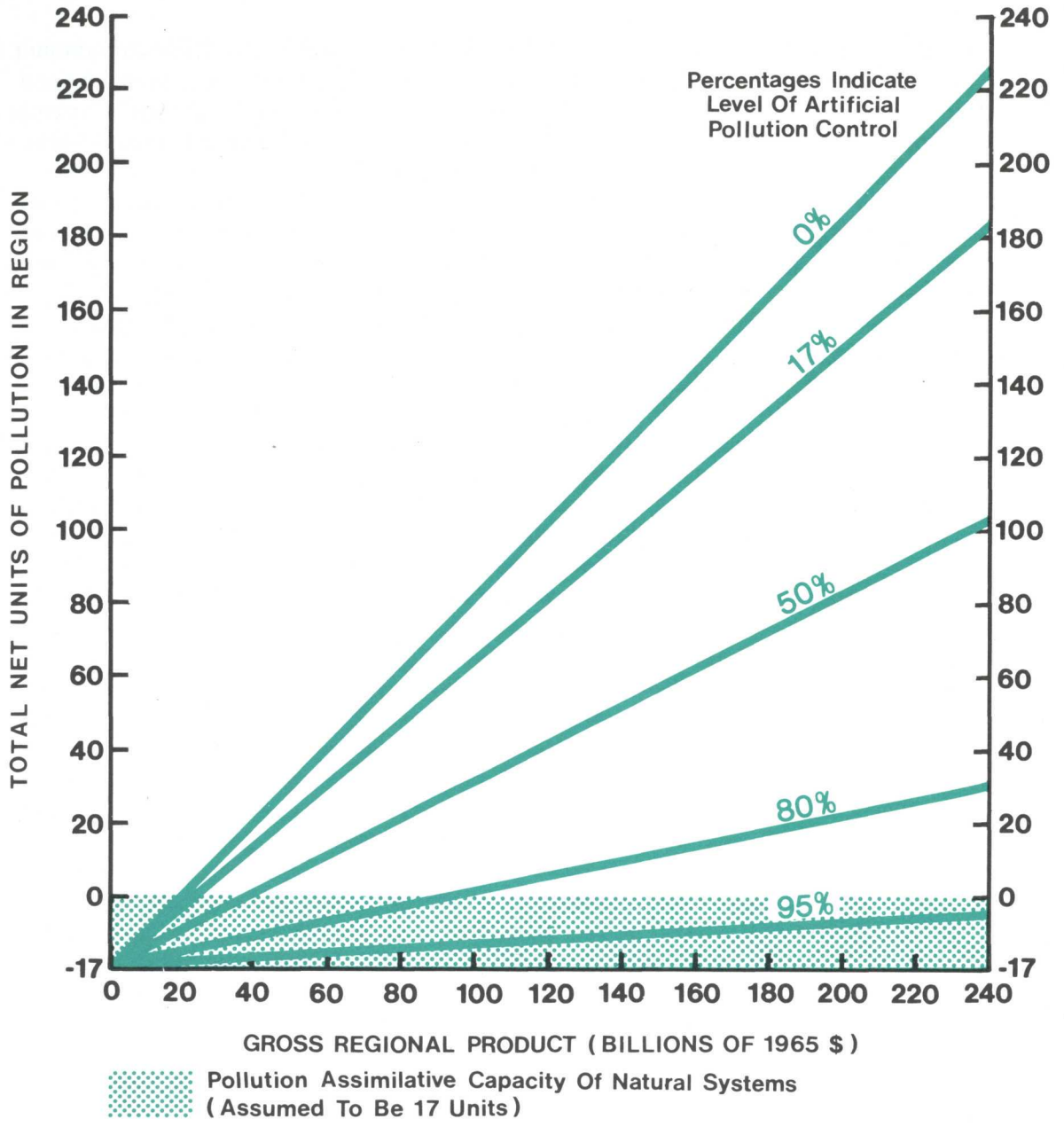

FIG. 9 UNITS OF POLLUTION WITH ALTERNATIVE COMBINATIONS OF GRP AND POLLUTION CONTROL

Assuming that no units of pollution occur until the pollution assimilative capacity of natural systems is reached and that after that point one unit of pollution is equivalent to $1 billion in gross regional product. The GRP in 1965 was $20.5 billion with 17% pollution control. Total pollutants produced were 20.5 X (100-17%) or 17 units. It is assumed that these units represented the full assimilative capacity of natural systems with the result that there were zero net units of pollution in 1965. (3.5 units were controlled artificially.) If a GRP of $240 billion and artificial pollution control of 80% are assumed, the net units of pollution would be 240 X(100-80%)-17, or 31.

perhaps between 5 and 10%. Let us assume 7%, making the total 17%. The exact amount is not critical. For example, it could vary 5%+ or—without a significant effect upon the end results (Figure 9). However, a more accurate determination should be made before attempting to implement the carrying capacity approach (discussed in Chapter VI and Figures 11 and 12).

In addition to artificial pollution control, we must account for the capacity of natural systems to assimilate waste. The capacity of natural systems must not be exceeded if the benchmark standards identified in Chapter III and Appendix 4 are to be met. In the Pacific Northwest in 1965 there was localized air pollution, water pollution, land abuse, visual pollution, and solid waste problems, for example. This indicated that the assimilative capacity of the natural systems had been exceeded locally. In many other areas, however, it appeared that the natural systems had additional pollution absorption capacity. If the pollution in 1965 had been distributed more widely it might have been absorbed by the natural systems without degradation. This is probably on the optimistic side and is debatable. However, for purposes of this study let us make such an assumption. That assumption would mean that, on a regional average basis, the combined capacity of the natural and the artificial systems was adequate to handle the total pollution load in 1965. An additional consideration is that once natural systems are overloaded, their waste assimilative capacity often is drastically reduced. However, for purposes of illustration and simplification, let us leave such a possibility for consideration with a more sophisticated approach.

A goal of either 100% artificial pollution control or zero waste per unit of GRP is unattainable from both the technological and economic standpoints. The cost and technical difficulty of reducing by artificial means the amount of pollutants from a given source increase rapidly as zero pollutants is approached. The absolute limit is reached when the pollutants created by the clean-up "servant machines" are as great as the reduction in pollutant levels caused by those "servant machines" utilized directly for production. There has been no overall assessment of what this ceiling on reduction of pollutants may be. There is only limited information for individual component industries. The best we can do at present is to assume a limit based upon partial information (this should be within a rather large ballpark) and revise it if needed as more complete information becomes available (a procedure illustrated in Chapter VI, Figures 11 and 12). Our assumption is 90%.

Another constraint is economic. The benefits (both material and intangible) resulting from additional investments for pollution control must exceed the costs. But here the law of diminishing returns becomes increasingly important as the 90% ceiling is approached. (An important potential added constraint is that the relative cost of energy—particularly oil and gas—needed to reduce the many diverse causes of pollution identified above is expected to increase by as much as 100% by the mid-1980's, and probably more in the future). Unfortunately, there is at present no reliable overall assessment of what the ultimate economic limits may be. Possibly they lie between 80 to 90%. Let us make an optimistic assumption of 90% and revise it in the future as more adequate information becomes available. Attainment of the resulting 80% ceiling (90% of 90%, rounded) would require a substantially increased application of (a) science and technology, (b) natural resource management, and (c) land use controls—beyond the scope of such measures in effect in the Northwest or anywhere in the

nation in 1972, or seriously contemplated. [24]

Every major link in the energy supply chain, from exploration, development, and extraction of mineral fuel reserves to eventual consumption and disposal of residuals, is damaging to the natural environment.[25]

In view of the foregoing discussion it appears valid to assume that, assuming no artificial or natural pollution control, $1 billion in GRP (equivalent to 4 million servant machines) results in one pollution unit. The number of pollution units then equals GRP (in billions of 1965 dollars) X (100% less percent of artificial pollution control). The relationships for five different percentages of artificial pollution control are depicted in Figure 9.

If the objective were to keep pollution at the 1965 level (assumed to coincide with the pollution assimilative capacity of natural systems) the gross product could not exceed $85 billion with 80% artificial pollution control, the assumed economic and technological ceiling [85 X (100-80%)-17]. If the standard should be changed to 51 pollution units for the region (three times the assimilative capacity of natural systems) the total GRP theoretically could be $340 billion (about 16-1/2 times the GRP in 1965). On the other hand, if only 17% pollution control prevails, a GRP of $340 billion theoretically could be attained only at the price of 265 pollution units (15-1/2 times the natural assimilative capacity). With no artificial pollution control a gross product of $17 billion could be attained and still have zero units of pollution. Obviously many other combinations of the three variables theoretically are possible. However, it would be impossible to reach the $208 billion GRP projected by OBERS for the year 2020 unless the level of pollution increased to about 25 units—net—(with 80% pollution control). This would represent about 2-1/2 times the natural assimilative capacity.

> *". . . I got interested in pollution as soon as I got off the earth and looked back. The environment got visibly and progressively worse over the three space flights I took in 1962, 1965 and 1968.*
>
> *The flights over the western part of the country gave me a good view of rapidly increasing pollution around Los Angeles, Houston and the Gulf Coast. On each trip, a light brown shading in the waters of the Texas coast extended farther and farther out into the Gulf of Mexico."*
>
> *Walter M. Schirra Jr.*
> *Conference on "Industry and Environment"*
> *Americana Hotel, New York City*
> *June 16, 1970*

---

[24] An illustration of pollution control limitations is the air quality of the Los Angeles Basin. Despite heroic measures since the early 1950's air quality has steadily deteriorated. From 1966 to 1970 an overall reduction was made in atmospheric hydrocarbons and carbon monoxide but this was more than canceled out by a sharp increase in nitrogen oxides (a major component of photochemical smog). From *The Closing Circle*, by Barry Commoner.

[25] Annual Report 1972, Resources for the Future, p. 16.

B. Capacity for Sustained Use of Natural Resources for Material Purposes

The next step in the carrying capacity approach after defining the theoretical options for GRP, percentage of pollution control, and total units of pollution is to assess the actual capacity of Northwest natural resources to provide the foundation for GRP indefinitely into the future.

The Northwest has certain inherent competitive advantages in manufacturing and marketing products and services based upon its native natural resources. But these resources are finite; their capacity to supply annually both the materials and the high quality working environment for management and employees that are the foundation for the Northwest economy is limited. With exponential growth rates these sustainable limits may be reached before the unwary realize what has happened. If the Northwest population should increase to the point that Northwest natural resources could not satisfy the demands on a sustained basis it might be possible to resort to importing more raw materials, resulting in a net import imbalance of natural resources, and "exporting Northwest labor." One point of view is that such an unfavorable natural resource trade balance would result in a reduction of per capita income as compared to competitive regions. Raw materials would be shipped in, manufactured locally, and the product shipped to other markets. Since the Northwest could maintain a technological edge only temporarily, the end result must be either abandonment of production or reduction of wages sufficient to meet world competition, plus shipping charges. Obviously this would be exclusive of industries that enjoy a contemporary competitive advantage because of Northwest low cost electricity, seaports, climate, high quality environment for management and employees, etc. It is highly improbable that an unfavorable natural resource trade balance would be or could be compatible with optimum livability for the Pacific Northwest. The study takes the position that in the final analysis there are no "non-extractive" industries.

In a mature worldwide economy, which we are approaching, more regions would process or manufacture or utilize their important native natural resources and raw materials locally—except when supplies exceed all expectations of future local needs. Many presently "undeveloped" nations will be reducing emphasis on exporting raw materials. Probably the volume of trade would increase, but more of it would be one type of manufactured goods exchanged for another. For example, in order to import increasing amounts of oil or automobiles, the Northwest must export, in raw or manufactured form, products based upon its own resources such as lumber, wheat, aluminum, or aircraft.[26]

One possible exception would be a region which could establish a permanent symbiotic relationship with a nearby region whereby one region, with abundant undeveloped natural resources such as minerals but with inhospitable climate, terrain, etc., (Sahara Desert or North Slope Alaska oil, for example) could maintain population and manufacturing at

---

[26] "We cannot ask other countries and other peoples to bear the burden of supplying our way of life. Moreover, by taking the resources of undeveloped countries now, we are forever removing a portion of whatever future betterment their land may hold for them. If human environment is a legitimate concern, then human squalor surely must be also. In honesty we cannot consciously trade one for the other anywhere else in the world to supply our particular wants." John D. Beaulieu in *The Ore Bin*, February 1973, published by the Oregon Dept. of Geology and Mineral Industries.

minimum levels and at the same time be a permanent supplier of raw materials or outdoor recreation and tourism opportunities or both, for another region or regions.

> *An indefinitely rising material standard of living has nearly the same effect on the biosphere as an indefinitely rising population. As with population, this problem must also be solved sooner or later.*
>
> *Report of the Study of Critical Environmental Problems,*[27]
> *Massachusetts Institute of Technology - 1970*

> *And yet the total rate by which men exploit the earth's ecosystem has some upper limit; if this rate is exceeded, the system will eventually be driven to collapse. Hence, all productive systems must eventually reach a no-growth condition . . . .*
>
> *Barry Commoner*[28]
> 1971

The foregoing line of reasoning is controversial; some economists disagree with it and also with the assumption that one basic requirement for sustained high quality livability for the Northwest is continuation of its natural resource based economy; they contend that natural resources are not limiting—that continuing advances in science and technology will overcome shortages in resources and permit unlimited increases in gross product.

Through new technology and the wider application of existing technology the output from renewable natural resources tends to increase as demand and prices increase. Concurrently, the cost of producing a unit of output tends to decline as the output per production unit increases. Also, increases in prices tend to stimulate the recycling of "waste," the production of substitutes, and the development of new technology to further increase both.

Under limited conditions the increased output may place little or no additional stress upon particular renewable natural resources. However, as we approach the productivity ceiling which is imposed by natural forces (such as solar energy and atmospheric carbon dioxide for photosynthesis), the effectiveness of man's technology tends to diminish. Also, with the possible exception of the early stages of technology, both the hazard of adverse consequences and the cost of maintaining artificial ecosystems tend to increase with each increase in the intensity of technology.

Principles similar to those discussed in the preceding two paragraphs appear to apply also to the progressive utilization of lower grade deposits of non-renewable natural resources such as minerals.

---

[27] "Report of the Study of Critical Environmental Problems," 1970, Massachusetts Institute of Technology Press, 28 Carleton Street, Cambridge, Massachusetts, 02142.

[28] Commoner, Barry, "The Closing Circle, Part II," *New Yorker Magazine*, October 2, 1971.

Despite the lack of universal acceptance; the approach used in this section is that an approximation of the long term carrying capacity of the Pacific Northwest as a whole, expressed in gross regional product, may be made by analyzing its available land and its natural and man-made resources. This approximation includes the assumption that the relatively good quantity and quality of Northwest capital, management, and labor would continue. It assumes that inter-regional and international trade will increase, limited however by the capacity of Northwest natural resources (see definition in glossary) to provide the base for such trade on a sustained basis. It is also based upon a cautious approach which recognizes that major future breakthroughs in science and technology that would avoid adverse environmental consequences are possible, but they are by no means assured; that the first priority should be a major reorientation of science and technology to correct the backlog of problems caused by economic growth such as eco-system disruption, poisons, eutrophication, soil erosion, maldistribution of population, excessive noise, and all manner of emissions and effluents; that a prudent procedure is to base assessments of sustainable future economic activity upon today's knowledge; that increases in those assessments are warranted (and provided for in Chapter VI) only after breakthroughs in science and technology that result from new knowledge are proven, after assessing negative trade-offs, to be positive steps in the direction of an optimum quality of life; that to take such positive breakthroughs for granted is playing Russian roulette with America's future.

Utilizing the concepts employed in this paper, one possibility is that a better ultimate balance within the region could be attained by a substantial shift in the distribution of future population and industrial growth between the 12 subregions recognized by the Pacific Northwest River Basins Commission (Figure 1). For example, in Subregion 11, Puget Sound, the population density in 1965 was 4.49 acres per person and the "servant machine" population about 0.34 acres per "servant" resulting in a total factor of 0.32 acres per person or equivalent, only slightly less concentrated than Japan (without considering the amount of pollution control in either Puget Sound or Japan). At the other extreme, in the Closed Basin (Subregion 12) the population density in 1965 was 857 acres per person and 78 acres per "servant machine." The overall figure was 71 acres per person or equivalent, only one-fourth the concentration of population and industry in Australia.

Since some subregions may have factors that place a special limit on the population equivalent that can be sustained without sacrificing environmental quality (such as limited water supply and a short growing season in Subregion 12, Closed Basin, or atmospheric congestion due to prevailing air temperature inversions in Subregion 9, Willamette Valley), a more realistic carrying capacity estimate for the region might be made by analyzing each subregion also. However, the first effort is for the region as a whole.

The results of this initial effort are summarized in Table 3. The procedures used for deriving these carrying capacity estimates for material purposes are explained in Appendix 6.

As explained in Chapter IV A, a level of artificial pollution control approaching 100% is virtually impossible; with 80% pollution control the GRP should be held to $85 billion if total pollution does not exceed 1965 levels. If the 1965 production of $3.3 billion (subtotal) for the first three basic industries is compared to the total GRP of $20.5 billion, a ratio of 1 to 6.2 is derived. If the same ratio is applied to the "sustained production potential" a total of $12.2 billion (subtotal) X 6.2 or $75.6 billion GRP is obtained—only $9.6 billion less than the $85 billion "ceiling."

The desire of the average resident to avoid pollution above 1965 levels is near unanimous; and since the attainment of the mix of material and intangible elements needed to attain the quality of life benchmark identified in Chapter III would tolerate no pollution above 1965 levels it appears that the natural resources have ample sustained yield capacity for GRP increases to the $85 billion level.

A factor of greater potential concern is the availability and cost of energy to fuel even a fourfold increase in GRP. This study assumes that energy will not be a limiting factor for Northwest growth in relation to other regions of the United States. But there is growing evidence that increasing costs and decreasing availability of energy sources and environmental problems associated with energy may sooner or later constrain economic growth of the nation as a whole.

A GRP of $85 billion for the Northwest would be over four times the level in 1965 and would require about four times the use of energy.[29] Probably electrical energy will comprise an increasingly larger share of the total energy needs than was the case in 1970. At that time the total energy used in the Pacific Northwest consisted of 43% electricity and 57% other forms.[30] Electrical energy is a convenient method for converting both falling water and various kinds of fuel into energy needed to power machines. Most authorities agree that, if equipped with the best available air pollution control devices, even fossil fuel electric generating plants produce far less pollutants than burning an equivalent amount of fossil fuel in individual motors. Under optimum conditions electricity would provide perhaps 75% of the total energy needs for the Northwest or nearly seven times the 1965 level of use of electricity, assuming combination 4b in Table 5.[31] Fusion, solar (including sea-thermal), and geothermal generating plants may eventually prove to be both feasible and relatively pollution free. Also, electrical energy can be used to produce by electrolysis an excellent pollution free portable fuel, hydrogen.[32]

---

[29] Energy consumption per capita is approximately proportional to per capita income—*Standard Oil Co. of California Bulletin*, Summer 1970. Also, report of National Economic Research Associates, Inc., *Congressional Record*, July 15, 1971, pp. E7702-7.

[30] For a comparison refer to a 1972 evaluation of California's electricity supply problems published by the Rand Corporation, Santa Monica, California—*"California's Electricity Quandary,"* in three volumes. The study was commissioned by the California Resources Agency and the California Committee on Planning and Land Use of the State Assembly. The study was co-sponsored by the Rockefeller Foundation and the National Science Foundation.

[31] Daly, Herman E., in "Electric Power, Employment and Economic Growth," before 1971 AAA S Convention. Also see *Congressional Record*, February 8, 1972, pp. S1364-9.

[32] Jones, Lawrence W., "Liquid Hydrogen as a Fuel for the Future," *Science*, October 22, 1971, Vol. 174; Anderson, J.H., "The Sea Plant; A Source of Power, Water and Food Without Pollution," International Solar Energy Conference, May 12,1971.

TABLE 3 - ESTIMATED POTENTIAL OF PACIFIC NORTHWEST RESOURCES TO PRODUCE CONTINUOUS GROSS REGIONAL PRODUCT
(Millions of 1965 dollars, rounded)

Resource Use for Material Purposes	Production 1965	OBERS 2020 Projections	Sustained Production[1] Potential in Year	
			20XX	20YY
Basic				
Commercial Forest Land	$ 1,670	$ 2,422	$ 3,340	$ 3,340
Agricultural Land	1,560	6,143	8,740	8,740
Commercial Fisheries	70	120	120	120
Subtotal	(3,300)	(8,685)	(12,200)	(12,200)
Recreation and Tourism	900	[2]	X	Y
Industry Based Upon Location	2,860	[2]	X	Y
Mining and Minerals	620	[2]	X	Y
Subtotal	(7,680)			
Ancillary				
Secondary Industries	12,770	[2]	X	Y
Total	**$20,450**	**$208,000**	$ X	$ Y

[1] The totals in the two columns, which include both numbers and the letters X and Y, are intended to illustrate a part of the study concept (Pathway B of Fig. 11). Numbers are used to indicate the production of commercial goods and services flowing from the yields of forest land, agricultural land and fisheries because carrying capacity principles have long been recognized for these renewable natural resources. Also an information base better than for other natural resource categories is available. In assessing the potential of the natural resource base to generate recreation and tourism, industry based upon location, mining and minerals, and secondary industry carrying capacity principles historically have not been similarly recognized. Less information is available and there has been inadequate study of possible changes in relationship, over time, between the "basic" and the "ancillary" categories. Consequently, the letters X and Y are used for indefinite time periods beyond the year 2000.

[2] OBERS uses sub-cateories other than those in Table 3 so a strict item-by-item comparison was not attempted for 2020. However, it is clear that OBERS projects substantially larger increases for "location" and "service" type industries than for forests and farm products. For example, OBERS projects that "chemicals" and "non-commodities" will increase 15 times by 2020. For basic procedures see Appendix 7.

TABLE 4 - Estimated Potential of Pacific Northwest Land and Resources to Yield Intangible Uses Needed for Benchmark Livability Standards

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Total Acres 1965 (1,000's)				Annual Carrying[1] Capacity of Dedicated Lands In Visits		Annual Capacity Needed for Benchmark - 1965		Surplus(s) or Deficit(d)[2] of Dedicated Areas in 1965		Additional[3] Dedicated Acres Needed Per Million	Dedicated Acreage Needed In Addition to 1965 Base (1,000's)		
BOR Recreation Class	Dedicated	Additional Available	Not Available	Totals	Per Acre	1965 Total (Millions)	Visits Per Capita	Million Visits for 5.8 Million	Capacity in Visits (Millions)	Acres (1,000's)	Population Increase After 1965 (1,000's)	For 10 Million Residents	For Assumed Non-Resident Use	Totals
I. Urban	20	Probably[4] Over 150	0	20	3,000	60	100	580	513(d)	171(d)	33	310	17 (5%)	327
II. Rural Sites	913	Nearly Unlimited[4]	0	913	250	228	4	23	205(s)	820(s)	16	None	None (50%)	None
III. Multiple Use (Except a & b)	76,719	59,128	21,675	157,522	1	77	12	70	7(s)	7,119(s)	12,000	43,281	12,000 (10%)	55,281
a. Wildlife Areas														
1. Hunting & Observation	Existing[5] Habitat Public Lands	Existing[5] Habitat Private Lands	4		2	15	4	23	8(d)	4,000(d)	2,000[6]	12,400[6]	1,000 (5%)	13,400
2. Fishing	Existing[5] Habitat Public Waters	Existing[5] Habitat Private Waters	4		20	23	4	23	0	0	200[6]	840[6]	400 (20%)	1,440[7]
b. Free Flowing[8] River Corridors (1970)	826 (2,580 miles)	2,422 (7,570 miles)	0	3,248 (10,150 miles)	12.5	10	2	12	2(d)	102(d) (320 mi.)	160 (500 mi.)	774 (2,420 mi.)	1,200 (75%) (3,750 mi.)	1,974 (6,170 mi.)
IV. Outstanding Natural Areas	2,935	0	0	2,935	25	73	6	35	38(s)	1,520(s)	240	None	65 (25%)	65
V. Wilderness[9]	6,340	5,628	0	11,968	0.5	3	0.3	2	1(s)	2,860(s)	600	None	2,660 (50%)	2,660
VI. Historic and Cultural Sites	43	4	4	43	3,000	129	2	12	117(s)	39(s)	0.7	None	None (50%)	None
TOTALS	87,796	64,244	21,675	173,715		618	134.3	780	155(d)	8,085(s)	15,249.7	57,605	17,342	75,147

[1] A recreation visit may be from 1 hour to 24 hours. If it extends beyond midnight of the first day it is counted as an additional visit or visits. The assumed average time per visit is : Class I & Class VI, 3 hours; Class V, 24 hours; remainder, 8 hours.

[2] For resident population only.

[3] After deficit or surplus has been satisfied.

[4] Presently included in BOR class III.

[5] Acreage included in BOR Classes III, IV, and V.

[6] Assuming no net loss in habitat available in 1965.

[7] Improvement of the fishery in existing lakes and reservoirs could be susbstituted for a substantial portion of the new fishing lakes.

[8] From Table 7 Recreation Appendix C-NP Framework Study, using 320 acres of corridor for each mile of free flowing river.

[9] From Table 8 Recreation Appendix C-NP Framework Study.

C. Capacity for Sustained Use of Natural Resources for Intangible Purposes

After making a preliminary estimate of the capacity of Northwest natural resources to sustain the demands of population and industry for commodity and commodity related products, the next task is to estimate the capacity of these same resources to sustain the needs for other less tangible items that ordinarily are not valued at the market place. Some of these intangible needs, which are prerequisite to the benchmark quality of life standards identified in Chapter III (and particularly Table 2, Figure 7, and Appendix 4) include health, education, full employment, assurance of basic essentials of life, protection from crime, equal opportunity, cultural opportunities, diversity, and freedom of choice. According to at least one evaluation,[33] the states of the Pacific Northwest at the present time rate only slightly above average among the 50 states in such intangibles, a 1973 study by the Midwest Research Institute (MRI) Kansas City, Mo., placed Oregon, Washington and Wyoming among the six states in the union which rated "excellent" in overall quality of life.

Implicit in this E & E study is the assumption that, other things being equal, the most hospitable conditions for further improvement in the satisfaction of such intangible needs require a healthy and inspiring outdoor environment readily available to everyone—clean air, clean water, quietness, ample open space, contact with nature including fish and wildlife, opportunity to escape urban pressures, and a wide variety of outdoor recreation opportunities. In other words assurance of a high quality outdoor environment through land, air, and water planning, through control of pollution and control of patterns of development and non-development will set the stage for potential improvements in the social and cultural intangibles in the long run. This does not infer that protection of the outdoor environment automatically will result in improved cultural advantages, health, education, and similar intangibles—only that the opportunity for such improvement will be enhanced. Because of its fundamental nature and its relationship to carrying capacity, priority attention in this study is devoted to the outdoor environment. Supplemental studies concerning standards and needs for other intangibles may be needed if carrying capacity concepts are further developed.

The requirements for pollution control and potentials for regional development as related to quality of life were discussed in Chapter IV A and B. The remaining portions of the outdoor environment to be discussed in subchapter C include open space, scenic attractiveness, wildlife, and outdoor recreation opportunities.

Benefits to the individual from both the natural and the man-made outdoor environment are in the form of all sorts of physical and mental well-being, peace of mind, exhilaration, esthetic satisfaction, comprehension of man's relationship with other parts of the natural and man-made world—not readily nor necessarily equatable with the material rewards that flow from the exploitation of natural resources. Wild areas are part of man's past and essential to his welfare. The biological rhythms of modern man, which shape his life, are often tied to the natural forces beyond his urban surroundings.[34]

---

[33] Berendt, John, "The Worst American State—A Statistical Reckoning," *Lifestyle Magazine*, November 1972, Vol. 1, No. 2.

[34] *The First Annual Report of the Council on Environmental Quality*, August 1970, Chapter IX, "Land Use—The Natural Environment."

Unique as we may think we are, we are nevertheless as likely to be genetically programmed to a natural habitat of clean air and a varied green landscape as any other mammal. To be relaxed and feel healthy usually means simply allowing our bodies to react in the way for which one hundred millions of years of evolution has equipped us. Physically and genetically, we appear best adapted to a tropical savanna, but as a cultural animal we utilize learned adaptations to cities and towns. For thousands of years we have tried in our houses to imitate not only the climate, but the setting of our evolutionary past; warm, humid air, green plants, and even animal companions. Today, if we can afford it, we may even build a greenhouse or swimming pool next to our living room, buy a place in the country, or at least take our children vacationing on the seashore. The specific physiological reactions to natural beauty and diversity, to the shapes and colors of nature (especially to green), to the motions and sounds of other animals, such as birds, we as yet do not comprehend. But it is evident that nature in our daily life should be thought of as a part of the biological need. It cannot be neglected in the discussions of resource policy for man.[35]

A realistic approach to an optimum environment for man must give overriding priority to protecting those portions of our heritage that provide our bonds with the natural world. Otherwise, through continued shortsighted pursuit of economic values or of ease and security as ends in themselves, we shall gradually but irretrievably destroy the potential for a full life for this and future generations. Our natural environment, once destroyed, cannot later be re-created. Although development of natural resources is necessary, we need to modify the way we go about it.

The best available common denominator for measuring the outdoor environment appears to be the recreation land classes originally recommended by the Outdoor Recreation Resources Review Commission in 1961 and adopted by the Bureau of Outdoor Recreation (BOR) in 1964.

Despite a lack of detail in the BOR classification system about urban and multiple use categories of recreation land and deficiencies in BOR's first national inventory, it does provide an acceptable framework for a beginning.

One purpose of the BOR system, as well as other similar systems and standards, is to help measure otherwise imponderable needs. The basic structure of the BOR system appears sound, but since the needs and carrying capacities have usually been measured in imprecise or relative amounts, some of the results summarized in Table 4 necessarily are subjective.

The acreage of dedicated and potentially available recreation land in each of six land classes and three sub-classes is determined. The carrying capacity in recreation visits per acre

---

[35] Iltis, H.H.; Andrews, P; and Loucks, O.L.;(University of Wisconsin biologists), "Criteria for an Optimum Environment," *Bulletin of Atomic Scientists,* January 1970.

per year for each class and sub-class is indicated. Also an estimate is made of the number of annual visits an average resident would make to each class of land per year under benchmark quality of life conditions. A percentage of non-resident use for each recreation land class is assumed.

The benchmark standards selected are based upon personal judgment. They are not supported by authoritative research reports because such research has not been conducted. Hence, the benchmark use figures should be considered as temporary and tentative until adequate studies are completed and more reliable information becomes available—a process discussed in Chapter VI and Figures 11 and 12. Also, it is emphasized that the suggested number of visits per capita are assumed standards—not forecasts or historical trend projections.

Additional discussion of the standards and rationale used in estimating carrying capacity for outdoor environmental purposes is found in Appendix 6B. A definition of the BOR recreation classes is in the glossary. Using the benchmark standards discussed in Appendix 6B, summarized in Table 4, it is evident that the most critical elements of the outdoor environment that would limit future population growth are located mostly on the 60% of Pacific Northwest land which is in public ownership. These values are wildlife areas, wilderness areas, outstanding natural areas, and wild and scenic rivers. The present supplies of these resources cannot be expanded. They are all that will ever be available. However, some of the areas, particularly those used by wildlife, could be improved or better managed.

In 1970 there was insufficient acreage of land dedicated to any of the above four purposes to serve the benchmark needs of a resident population of 10 million, plus an assumed percentage of use by non-residents. However, if all or most of the lands that qualified were also dedicated there would be sufficient. But much of the otherwise qualified acreage would not be ideally located since it lies in portions of the region the farthest from population centers.

Presently, as compared to the benchmark standards, there is a large deficiency of land in Northwest urban areas devoted to recreation and open space purposes. But sufficient open land is available which could be dedicated to such purposes for present urban centers; also new urban centers could be created with ample dedicated open space from the inception. Theoretically, the availability of urban recreation and open land should not place a constraint upon future Northwest growth. However, poor performance in both preserving and developing public use areas in urban centers in the past and the difficulty in insuring adequate funds, authority and integrity of long range planning, give little reason for optimism.

A truly farsighted approach to long range planning avoids irrevocable commitments now on all the land and resources. It leaves a significant percentage undeveloped so that future generations can exercise their own options in light of future conditions, values, and social organization—conditions that we presently cannot foresee.

In summary, using the standards employed in this study, land and resources of the Pacific Northwest, if managed according to sufficiently comprehensive and farsighted planning,

are adequate to permit use of the outdoor environment by 10 million residents, plus about 25% use by non-residents. Population growth beyond that point probably would be at the expense of the quality of life for the average resident. The most fragile areas, such as wilderness and wild rivers, would be the first to be overused (or use denied).

Of course sacrifice of some of the outdoor environment amenities would leave a type of environment "acceptable" to many people. However, once living conditions deteriorate below the peak attainable, the difficulty of regaining such a high standard probably would increase exponentially as compared to the arithmetic rate of decline.[36] Obviously it is far easier, and more compatible with the almost universal desire for personal freedom, diversity, and for multiple choices, to keep population and industry at levels that permit the optimum use of the limited supply of resources which yield outdoor environmental values than it is to allow excessive growth, then attempt to remove some of that growth and restore natural values in order to regain optimum livability.

[36] Jacoby, Neil H., *Center Magazine*, November–December 1970.

CHAPTER V

ALTERNATIVE GOALS FOR POPULATION, ECONOMIC ACTIVITY, AND INTANGIBLE VALUES

There is no question that we (the United States) are going to have a growth policy. The question is whether it's going to be active or passive, productive or counter-productive, and whether there is sufficient political courage to define goals with which many may not agree.

Congressman Thomas Ashley of Ohio

Although there has been intensive resource planning in the past, there remains a major and continuing need for additional planning and management at Federal, State, and local government levels, as well as in private business. A wide disparity presently exists between the adequacy of intensive and extensive levels and the short-range and long-range time frames of planning. The cause of this disparity often has been the failure of planners to develop several alternative long-range goals and objectives and early in the planning process (as soon as a good data base is available), subject these to full public scrutiny, debate and development of a consensus concerning the most desirable option.

Often goals and objectives are glossed over or have been left to evolve during the planning effort. This essential, but often neglected, early step in the planning process may be proposed initially in rather broad language. Later it requires refinement and more careful definition as operational programs are developed. The goal-setting concept is widely accepted in planning theory, but in actual practice much natural resource planning has been done in the absence of comprehensive, clearly defined long-range societal goals. The penalties of this omission are severe. Frequently results are plans that are without public support, are uncoordinated, conflicting, or outdated before implementation can begin. Plans which are not based upon explicit comprehensive goals chosen in advance by the public nevertheless usually include implicit limited goals based upon the interest and value judgment of those who prepared the plan.

Conversely, some striking achievements are attributable to imaginative, even visionary goal-setting. Goals provide the direction to planning that is so essential in order to provide room for new information, new concepts, and innovations. Sources of new concepts and new information that will lead to widely accepted goals must include governmental units, nongovernmental sources, the infeeding of ideas from the public, business, research, academic institutions, and others.

By the early identification of alternative goals, interest and active participation by all elements of the public in the entire planning process is stimulated. This goal-setting should be oriented toward both the generalized long-range and the more specific needs and desires that are relatively close at hand. Traditionally, goal-setting for clearly identified limited purpose short-range goals has met with success. Characteristically, man is able to direct his energies to short-range goals upon which agreement can be reached. In the early 1960's, a

goal was identified to put an American on the moon by 1970. This was a clearly defined goal which resulted in a successful effort. Even more specifically, the goal of establishing wild and scenic rivers has led to well identified planning efforts oriented toward reaching this goal. Trying to establish goals as to what kind of region we want in 50 years has not met with the same kind of success. But the process of trying to target on long range goals frequently stimulates the development of innovative planning alternatives.

Briefly, goals may be defined as a future state of affairs that a person, organization, entity, or society in a geographic area is attempting to realize. They may be either explicit or implicit, or a combination of the two. Both plans and operating policies can be effectively measured against goals. Goals suggest or define the need for timely information. There is a strong relationship among problems, goals, policy, and information. Information is needed to confirm and define the need for action programs. Policy is needed to guide actions by which goals may be achieved. Problem descriptions help to identify the need for policy and plans. The lack of information identifies the need for research. Goal-setting is an integral step in an endless process yielding improved planning and management.

Generalized goals of society in the United States can be identified in no order of priority as:

1. Ecosystem Protection – to maintain or create a pleasant place for people to live while maintaining ample diversity in natural systems and with minimal impacts on air-soil-plant-animal-water relationships.

2. Economic Growth – to insure consistent production and achieve agreed levels of economic growth by efficient allocation of resources.

3. Political Stability – to maintain the maximum freedom of choice and equality of opportunity.

4. Social Improvement – to make progress toward realizing full creative potential and self-fulfillment aims for each individual while maintaining social stability, responsiveness and high espirit de corps.

5. Health and Safety – to provide comprehensive programs for health and safety of the people of an area.

6. Technological Innovation – to develop new information and techniques through study, research, innovative thinking and experimentation.

7. Natural Resource Conservation – to optimally provide for land, energy, water and air resources through orderly use and preservation and to enhance their potential for future use.

8. Leisure – to increase the availability and choice of recreational time opportunity consistent with people's desires, social needs and capabilities.

Such goals are not all-inclusive and frequently not explicit, but they do represent wants and needs which should be considered in any program for conservation and development of a region. A considerable interrelatedness exists between these goals. For example, an activity oriented toward the goal of economic growth will directly influence the goals of environmental protection, conservation, and leisure. But planning has tended to orient itself toward maximizing limited purpose goals with little regard to others. What is needed in the Pacific Northwest is to establish umbrella goals for population, economic activity, and intangible values which incorporate the interrelationships and reflect the best living environment attainable for this region. What should a given area be like for ourselves, our children, and our grandchildren? What is it that we the public are trying to do?

Carrying capacity is one technique for coordinating limited purpose goals, and for determining the umbrella societal goals that are attainable in the Pacific Northwest and their relationship to a quality of life benchmark.

Discussion in Chapter IV identified on a tentative basis a potential natural resource carrying capacity for material purposes of at least $85 billion, with pollution held at 1965 levels. The potential natural resource carrying capacity for intangible purposes was tentatively identified as 10 million residents (allowing for non-resident use of different classes of recreation land averaging about 25%). This is about 2 million less population than OBERS projects for 2020. If past trends continue, the Northwest population would exceed 9 million by the year 2000.

Within the $85 billion in GRP, what are the options for population and per capita share of gross product and how do these relate to the benchmark per capita income and the population carrying capacity for intangible purposes identified in Chapters III and IV? These are shown in Table 5 and Figure 10. They are subject to revision according to procedures outlined later in Chapter V and in Chapter VI and Figures 11 and 12.

With a benchmark per capita annual income of $7,500 ($9,500 in per capita share of GRP) and 80% pollution control, the tentative regional population should be not over 9 million. Such a population would be within the carrying capacity for intangibles or amenities (with about 10% margin). Also, the "average" person would have 37 servant machines, and retain the benefits of their use in terms of material goods and services, compared to 13 in 1965. But the pollution caused by each machine would be only one-fourth as much because the amount produced by each machine would be reduced from 83% (in 1965) to 20% (before the $85 billion gross product level is reached).

As another example, if the goal were to stay within the long range carrying capacity for the Pacific Northwest, and if the regional population should increase to 11 million, the per capita share of GRP should not exceed $6,200 (in constant 1965 dollars). But this would be below the benchmark standards as far as material goods and services are concerned. Obviously, many other combinations are possible, but based upon the present knowledge as interpreted in this study, any that result in an eventual regional population in excess of 10 million or a gross regional product of $85 billion annually (with 80 percent pollution control) would exceed the capacity of Northwest resources to sustain such activity within the bench-

mark quality of life standards.

Some question that $7,500 in average per capita income is either an attainable, or a desirable goal. Others might opt for more than 10 million people, more than $7,500 per year income, more pollution, and be willing to write off the intangible natural values. This has been the trend of past events. It is the probable future course unless much more emphasis is placed upon comprehensive long-range land and resource planning and implementation of those plans. A major change in our methods of deciding upon long-range goals and priorities would be essential. We must now begin to give first priority to deciding where not to build, exploit, and develop. Development can then be skillfully shaped around the areas and values reserved.

The carrying capacity estimates in this study are not "fixed for all time"; neither is the benchmark definition of quality of life, nor the 80% ceiling on reduction of adverse effects of production. As new knowledge, new methods of resource management, new technology, and better understanding of man's social and environmental needs are discovered, thoroughly tested and proven, adjustments should be made as outlined in Chapter VI and Figures 11 and 12. For example, a percentage correction factor could be applied to the $250 per servant machine if actual experience demonstrates that the Pacific Northwest gross product mix in the future has a different adverse effect per servant machine than in 1965. However, the assumption should not be made that new knowledge will always make possible upper adjustments in growth of population and production. The opposite could occur.

TABLE 5 - Estimated Capacity of Pacific Northwest Natural Resources to Support Population and Gross Regional Product With Different Percentages of Pollution Control

Combination	Population	Per Capita Share GRP in 1965 $	Percent of Pollution Control	Total GRP	Pollution[2] Units	Servant Machines Per Capita	
						No.	% Impact Per Machine[1]
	(Millions)			(Billion $)			
1965 assuming no pollution control	5.8	$3,520	0	$20.5[3]	3.5	13	100%
1965 actual	5.8	3,520	17(est.)	20.5	0	13	83
1[3] a	5.1	5,100[4]	34	26	0	19	66
b	2.7	9,500[5]	34			37	66
2[3] a	6.9	5,100	51	35	0	19	49
b	3.7	9,500	51			37	49
3[3] a	10.4	5,100	68	53	0	19	32
b	5.6	9,500	68			37	32
4[3] a	16.7	5,100	80	85	0	19	20
b	9.0	9,500	80			37	20
5[3] a	22.7	5,100	85	116	0	19	15
b	12.2	9,500	85			37	15
c	6.9	16,700[6]	85			66	15
6[3] a	22.7	5,100	95	116	−11	19	5
b	12.2	9,500	95			37	5
c	6.9	16,700	95			66	5

[1] Relative amount of pollution caused by each servant machine (equivalent to $250 in per capita share of GRP) assuming 100% of potential pollution results if there is zero control (Impact = 100% less percent of pollution control). Reductions in pollution caused by each servant machine are assumed to consist of (a) improved technology resulting in less waste, (b) more emphasis on products that have less environmental impact and (c) permanent control of waste produced. The annual impact caused by each person is assumed to remain constant—equivalent to the production of $250 in gross product.

[2] Artificial units—obtained by multiplying GRP in billions X (100% less percent of pollution control) and subtracting the pollution units controlled by natural systems (17).

[3] From Table 3.

[4] The amount projected for 1980 (Table 7).

[5] The benchmark amount needed as discussed in Chapter III. B.

[6] The amount projected by OBERS for 2020.

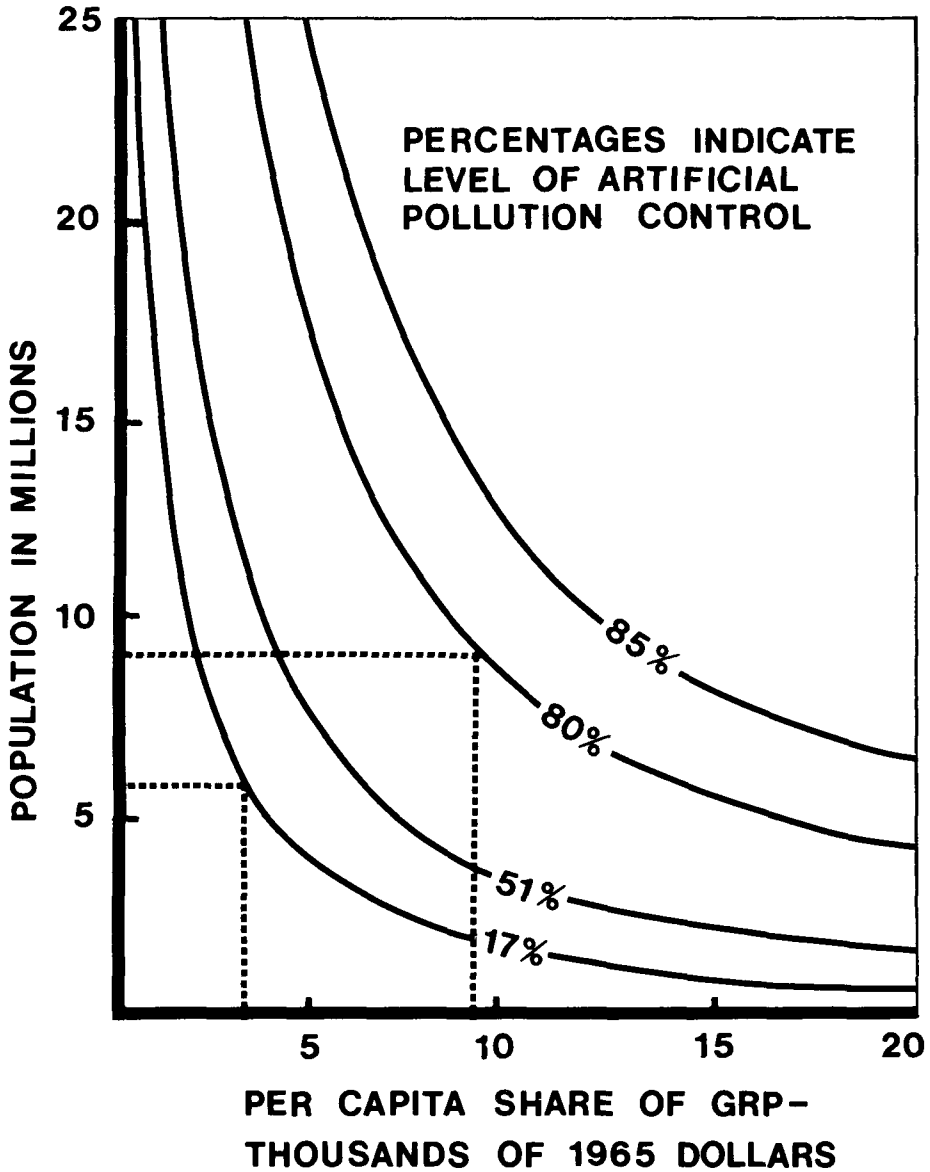

FIG. 10 CARRYING CAPACITY WITH FOUR LEVELS OF POLLUTION CONTROL.

The estimated capacity of Pacific Northwest lands and resources to sustain indefinitely, at the 1965 level of environmental quality (assumed to be zero pollution units), various combinations of population and per capita share of gross regional product—with four levels of pollution control.

Population in 1965 was 5.8 million; per capita share of GRP $3,520; artificial pollution control approximately 17%. With artificial pollution control at 80% and a benchmark per capita share of GRP of $9,500, a regional population of 9 million could be sustained with pollution no greater than in 1965.

Derived from equations used for Fig. 8 and Table 5. 1965 pollution (zero units) = [(Per capita GRP-M X Population-MM) X (100 - % of pollution control)] - 17.

CHAPTER VI

IMPLEMENTATION

A. Overview

This study utilizes both established planning principles and innovations to evaluate the capacity of the natural resources of a region to sustain indefinitely alternative combinations of population, economic activity, and protection of intangible values. The capacity is in relationship to assumed average standards per capita for income, for quality of air, land, and water, and for the outdoor environment. The study presents a concept for weighing alternative blends of economic factors and ecologic factors as a part of the process of establishing long range regional goals. It presents a future-oriented approach to long range goal setting. It would be no panacea. It is only the first step in a long and difficult process. Testing would require a similar effort for several subregions, then an adjustment of the regional assessments as appropriate. Use of the concept would involve a much higher degree of self-discipline and coordinated action by the various private interests and governmental entities than has been evident in the past but it should preserve and even enhance our democratic form of government. It also is an application of the viewpoint that man must live in harmony with his natural environment.

The very essence of democracy is planning for the future.[37]

The carrying capacity approach would take the optimistic view than man is not at the mercy of uncontrollable forces but does have the intelligence and the foresight to control his own collective destiny. Reaching a public consensus concerning long range goals would be a difficult but not impossible task. It would require some early sacrifices and self-imposed disciplines. It would be comparable to investing in major fire prevention measures. It would require some guidance of population growth and the economic system in order to protect the overall quality of life over the long term. At the same time, it would retain as much as possible of the advantages of open competition, a free market, and freedom from public regulation.

The study describes a quality of life benchmark and discusses 15 categories of living expenses that are considered essential to its attainment. The fact that a high quality of life, perhaps an "optimum" quality, is still available as a viable alternative goal places the Pacific Northwest region in an enviable position.

The study is neither a comprehensive regional plan nor a design for such a plan. But it does suggest a prototype system for establishing a solid foundation of goals upon which balanced comprehensive regional and subregional plans could be built and implemented.

B. Probable Obstacles

Obstacles to the adoption and implementation of the carrying capacity or space-ship

[37] Georgia legislator Gerald Horton, before the Fifth Governor's Conservation Congress, Portland, Ore., November 20, 1972.

earth, closed system concept, are formidable. Also, pioneering efforts, particularly those that involve the basic interests of most of the people, frequently encounter skepticism and cause consternation. This one is no exception. Some of the estimates made in this study are based on solid data; others on more tenuous information. Some of the concepts are known and accepted; others are new and untried. The study is interdisciplinary; it is also complex and highly interrelated. The chances are that the techniques employed and the balances chosen will not please everyone even after further improvement and refinement.

Some may be fundamentally opposed to the idea of reducing any of the traditional freedom to pursue their individual immediate goals and concentrating more effort on long range collective goals. They may resist any kind of change. Others may fault the "servant machine" illustration; or the benchmark quality of life definition and its 15 "elements"; they may feel the $7,500 in per capita income is inadequate or too much; there is also the question of whether the average person would possess the capacity to utilize the $7,500 in a way that would benefit society; and there is the larger question of whether the United States still has the drive, the energy resources, the technology, and the ingenuity to achieve a 170 percent increase in productive efficiency per man hour over 1965 levels; on the other hand there is a question whether the United States and the Northwest would be able to sustain a material standard of living far higher than limited world resources would permit for the bulk of the world population. Others may object to the idea that neither population nor gross product can expand forever; or they may consider the relationship used between the attainable gross product and the percentage of pollution control as an oversimplification; some may disagree with the concept of a hierarchy of human needs or of basic versus secondary industries; or they may object to the benchmark standard used for intangible use of resources or the carrying capacities of various classes of recreation land.

Potential users of this new approach to long range planning and goal setting are urged to concentrate initially upon the overview and the basic concepts presented. If these are adjudged sound, then it would be appropriate to focus upon individual items that may need adjustment or more detailed or sophisticated treatment. Anyone who is not satisfied with the study is challenged to suggest either improvements in the methods used or an entirely different and better system. Most pioneering methods require a period of trial and error before they work well.

The largest obstacle, however, is likely to be governmental and public inertia, the limited scope and short time span of interest of the majority in any kind of long range planning. Another problem is that it involves getting out ahead of public opinion rather than lagging behind. Americans traditionally have reached a consensus sufficient to commit adequate resources to solve a problem only after there has been some kind of catastrophe or a confrontation with what appears to be a critical situation. A paraphrasing of Gresham's "law" applied to public administration is likely to be a major factor. It reads, "The pressure of day-to-day problems, each with short deadlines, tends to drive out long range planning."

> *We must recognize that the goal of a cleaner environment will not be achieved by rhetoric on moral dedication alone. It will not be cheap or easy and the costs will have to be borne by each citizen, consumer and taxpayer. How clean is clean*

regional and area associations of governments could provide organization forms for the preparation of plans based on the evaluation of carrying capacity information along with other more traditional data.

2. Major Policy Legislation

Action at the national level in the form of growth policy, land use policy, environmental policy, or other national goals can influence growth and development trends. Legislation leading to the programs administered by the Environmental Protection Agency, for example, can have an influence on the location of new economic activity as well as correcting adverse conditions caused by existing economic activity. National legislation often emphasizes incentives and obligations for states to act. It often encourages companion state legislation.

At the state level, legislation can set standards directly or provide a base for local government regulation of land use. Controls such as land subdivision standards, zoning, and other land use regulation are primarily developed at the city and county level but such measures are receiving more attention at the state level. The land use controls of the past have served primarily to coordinate separate private development proposals and reduce localized conflicts, such as keeping the pig iron smelter out of the residential parlor. However, increasing attention is being given to land use controls as a means for protecting natural resources such as prime farm land or river flood plains. The long range carrying capacity of a region can be affected significantly, depending upon the extent to which basic resources are retained in a continuing renewable form. Since such resource goals have a regional rather than a local significance, state government will most likely need to exert a leadership role in any program to use land use controls as a means for resource conservation and development.

3. Reorganization of Government

A major task is to overhaul the myriad of overlapping, uncoordinated agencies of government at all levels. Departments of Natural Resources, both nationally and at the state levels might be a step in the right direction. These departments offer hope for much better coordination in our land use, energy, water, and air policies and programs. We also need effective organization for coordinated management of natural resources in multi-state regions, and at the state level, for multi-county regions.

At the national level there needs to be better correlation between the Council on Environmental Quality, the Council of Economic Advisors, the Water Resources Council and a Department of Natural Resources. We need reliable indices, expressed in a common terminology and a common measuring system, for environmental quality as well as for economic activity and for natural resource supply. (The latter provides the foundation for the other two.) We must be able to assess the consequences of a change in activity in one category upon the other two—to measure the trade-offs.

Assuming that land use policy legislation is enacted, Departments of Natural Resources created, and better correlation between environmental quality, economic activity, and natural

enough can only be answered in terms of how much we are willing to pay and how soon we seek success. The effects of such decisions on our domestic economic concerns—jobs, prices, foreign competition—require explicit and rigorous analysis to permit us to maintain a healthy economy while we seek a healthy environment.

President Richard Nixon
Message to Congress
August, 1971

C. Opportunities for Further Development and Implementation

Although the carrying capacity concept is in its infancy and is untested as far as the population, economic activity, and intangibles of a large geographic area is concerned, it is not too early to speculate about the practical aspects of implementation.

Means Available

Even a cursory examination reveals a number of means that are presently available to provide financial and other incentives and guidance for the direction and rate for population and industrial growth patterns that standards used in this study indicate are important to the quality of life in the future. The most obvious of these are discussed briefly below. These are proven techniques fully in accord with traditional democratic principles. Most of them have long been used in the United States to promote or accommodate growth and development and will continue to be used for such purpose. They could be equally available to dampen or channel that growth. They should be applied equally to both residents and potential new residents. Most of them could induce feedback in the market system that would slow or halt the more damaging kinds of growth.

1. Full public information and education

To set a solid foundation for a sustained effort to achieve the highest attainable and sustainable quality of life, first priority should be devoted to full public information and education about natural resources, population, pollution, and growth potential. The interrelationships between natural resources, science and technology, population, economic growth, and quality of life needs much more attention at all education levels. The Federal Department of Health, Education, and Welfare needs to give far more emphasis to the interrelationships and to environmental education. State systems of education must devise far more effective means of endowing all students and graduates with a better balanced perspective of man's relationship to nature—for example, to bridge the gap between economics and engineering on the one hand and ecology and biology on the other.

One of the most effective ways for assembling and evaluating the basic information is by regions. River basin commissions have areas of geographic interest which suggest that they should be uniquely appropriate for organizing such information. In many cases, information can first be developed for a sub-basin, state, or state subregion. States and

resource supply attained, a large number of qualified agents to help explain the situation at the grass roots level over a period of years might be an effective tool. An example of a successful program of this type is the Cooperative Extension Service sponsored by the U.S. Department of Agriculture and the land grant universities. This service to farmers in the last 50 years has been a major factor in promoting a greatly increased volume and quality of agricultural production in the United States. Perhaps a similar approach could be equally beneficial in urban and rural land use and water and energy planning (including population and economic growth and environmental quality).

4. Public Service Facilities

The location, capacity, and cost of public service facilities has a profound influence on the location and nature of private development. In addition, public facilities often enhance the livability of an area or provide benefits for the population of a larger region. Examples are:

a. Transportation facilities such as highways, waterways, airports, railroads, and docks.

b. Water supplies and liquid and solid waste disposal systems.

c. Energy forms such as electric power, and natural gas.

d. Schools, recreation facilities, hospitals, and communication facilities.

To illustrate, the location of a major thoroughfare through the center of an agriculturally rich valley can stimulate the conversion of the farm land to non-farm uses. Location of an electric power generation plant may move some future economic growth nearer to the plant location if rate policies reflect the transmission savings. Many other examples could be given of the way in which provisions for public service facilities can have an impact on population distribution and economic activity.

5. Other Public or Quasi-Public Programs

Various other programs can have an important impact on the location and nature of growth and no-growth trends. In the absence of a popular consensus concerning growth goals, and the resulting absence of explicit and coordinated public policy and legislation concerning growth, public officials in executive and administrative positions—Federal, State, and local—have considerable latitude in interpreting and implementing regulations and other measures which have an important effect upon future growth. Their attitudes frequently reflect their individual interests, backgrounds, and the views of their principal constituency. Their attitudes affect their identification of the need for new legislation and the way they promote and interpret such legislation.

Examples of such public or quasi-programs are:

a. Financial and other incentives for new industries on the one hand or special charges or requirements on the other. An example would be the question of whether port

districts should provide subsidies for industrial site development or state or Federal agencies should subsidize irrigation.

b. Public acquisition or disposal of key tracts of land (or development rights), and control of resource development, settlement, and use of lands in public ownership.

c. Regulation of land speculation and real estate promotion. An illustration of a possibility for re-interpreting existing legislation is a 1937 law of the State of Washington which requires that before a city or county may approve a subdivision there must be a finding that "the public use and interest will be served or advantaged."

d. Reserving "public interest" covenants in land titles.

e. Enforcement of anti-pollution laws and regulations and promoting the authorization of effluent and emission charges.

f. Interpreting tax laws and promoting needed reforms.

g. Interpreting legislation concerning welfare and family planning and promoting needed reforms.

6. Independent Private Programs

The potential for effective private programs is very large. Concerns owning natural resources could adopt carrying capacity principles for their own holdings. Each industry could provide a degree of self-regulation and suggest public regulatory programs that the industry is unable to control or patrol. A vast influence is exerted by banks, building and loan associations, and other financial institutions through the control of credit for development projects. Several private concerns are organized for essentially public purposes. Examples are some private foundations. Another example—a concern which acquires key tracts of land for essentially public purposes—is The Nature Conservancy. The bulk of research and development of improved pollution control techniques and the day to day operation of artificial pollution control measures will continue to be the responsibility of private business concerns.

Of the six categories of possible means for implementing the carrying capacity concept discussed above, the indispensable elements appear to be as a minimum (1) full public information, (2) a popular consensus of what the goals should be, and (3) effective land use and energy planning and controls.

> *When men mutally agree to pass laws against robbing, mankind becomes more free, not less so. Individuals locked into the logic of the commons are free only to bring on universal ruin; once they see the necessity of mutual coercion, they become free to pursue other goals. Freedom is the recognition of necessity.*
>
> *Garrett Hardin, in "The Tragedy of the Commons," 1968*[38]

---

[38] "Tragedy of the Commons," Garrett Hardin, *Science*, December 13, 1968, Vol. 162. American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington D.C., 20005.

The fact that proven tools are available does not mean that long range goals will magically evolve and the tools to implement them automatically be used for such purpose. A major and constantly increasing multi-pronged effort by influential persons and interests representing a cross section of our society would be essential. At all levels we need to replace with solid facts the rhetoric and exaggeration of both the instant environmentalists and the addicts of exponential growth.

Research Needs

Regardless of whether carrying capacity concepts are adopted nationally, regionally, by states, or not at all, a better foundation of facts and different ways of assimilating the information would be highly useful for long range planning purposes. Considerable research and field testing would be needed to obtain the information. Some examples (in no order of priority) are:

1. Economic activity, environmental quality, and natural resource supply indices should be on a par (receive equal emphasis) and be based on a common framework of data compilation, assumptions, methodology, and language so that one can be readily compared with the other two and accurate interrelationships and trade-offs determined. All official reports, statistics, etc., should reflect this common framework.

2. A common natural resource inventory data system used by all national, regional, state, and local planning and program agencies and private interests is needed as is a system for keeping it updated continuously.

3. There needs to be a standard definition of various categories and subcategories of pollutants.

4. A technique for determining capacity of natural systems to assimilate various categories of pollutants without degrading ecosytems needs to be perfected.

5. A system is needed for measuring the percentage of existing artificial pollution control by various categories and subcategories.

6. Accurate methods for determining the technological and economic upper limits for artificial control of various categories of pollutants are needed. Also some method for weighing the various categories to get an overall figure would be very useful.

7. A common system for monitoring all major types of pollutants and several subcategories is needed.

8. The relationships between natural resources and economic activity need considerable clarification. In particular the natural resources which support "industries based upon location" need attention. Also, the percentage relationships between "basic" and "secondary" industries and potential future changes has had inadequate study. All studies in this category should be multidisiplinary.

9. The extent to which the carrying capacity of various renewable natural resources

can be increased and the life of non-renewable resources extended by management intensity, science and technology, conservation, and recycling is a fertile field for research.

10. The carrying capacity of various categories of renewable natural resources in terms of human use and enjoyment needs to be determined.

11. A considerable effort should be devoted to studying "optimums" for the long range future in terms of per capita income (with various subcategories) and intangibles (with various subcategories).

12. Supplemental studies are needed concerning needs and standards for health, education, cultural opportunities, equal opportunity, freedom of choice, and similar intangibles, and how they relate to carrying capacity and to quality of life.

The Pacific Northwest as a Test Region

The Pacific Northwest River Basins Commission, the nation's first such commission, and the only organization which has been assigned the responsibility for comprehensive, interagency long range water and related land resource planning for the Pacific Northwest, now has the opportunity to try out the prototype system of displaying alternative goals outlined in this study. By publishing the E & E study it is making a contribution toward public understanding. The Pacific Northwest Governors also will have an opportunity to test the carrying capacity concept in any regional approach to planning, development, and preservation they may individually or jointly undertake. It should be of interest to the Water Resources Council and the Council on Environmental Quality. Also to other river basin commissions, interagency committees, and other organizations engaged in resource planning.

Several long range planning efforts aimed particularly at environmental quality have begun recently in western states.

Hawaii has a Year-2000 Commission and, since 1961, statewide land use planning.

The organization "California Tomorrow" has made a draft sketch plan for an environmental-economic program for that state to the year 2000.

In Oregon, the Willamette Valley Council of Governments, in coordination with the State Executive Department, adopted in May 1971 a design for a Willamette Valley Environmental Protection and Development Plan to the year 2000. The schedule anticipates completion of the plan in two years.

Oregon State University in 1972 began a three year effort funded by the Rockefeller Foundation to present scenarios of alternative futures for the Willamette Valley and adjacent areas in Oregon.

A draft of a long range master plan for the Lake Tahoe Basin (California) prepared by the Tahoe Regional Planning Agency was presented for public discussion in May 1971. One

unique feature of that plan is a proposed ceiling on population of 134,000—the calculated sustained carrying capacity of the basin. The plan adopted by the agency, although different from the original draft, still establishes in effect, a population ceiling for the basin. In 1973 it is the basis for day-to-day decision making by local, state, and Federal agencies, and private business concerns.

In November of 1971 the people of Marin County, California, by a 9 to 1 margin voted for a no-further growth policy.

The Los Angeles City Council, in a July 16, 1972, report to Mayor Yorty, recommended a 4.1 million ceiling on the number of people who could live in the city by 1990. Three weeks later the planning commission adopted a 20 year zoning plan designed to limit population to 3.4 million. (The 1972 population is about 2.8 million.) In late September, 1972, the Los Angeles County Board of Supervisors voted to freeze building permits on 1.8 million acres of county land and 9,000,000 acres held by private builders and speculators. Henceforth, permits will be considered only if plans call for no more than one unit per acre.

The city of Boulder, Colorado, has taken measures to stabilize its population at 67,000.

A dialogue between the Pacific Northwest River Basins Commission, the above planning groups, and others with similar missions should prove to be mutally beneficial.

If the Commission, or other long range planning groups, determines that the basic precepts included in this study have merit, a next step could be to supplement the existing water and related land information and plans with equally good information and plans concerning urban and rural land use planning, air quality, transportation, etc. This would be facilitated if a national land use policy act were adopted. Also, a common regional system for recording, retrieving, and updating the basic inventory information would help.

Even without the land use plans, the proposed system for goal setting could be applied to subdivisions of the Northwest region. These could be the 12 subregions recognized by the Commission, or some other combination of geographic areas. Regardless of what subdivisions may be selected, it would be more difficult to make reliable estimates of carrying capacities for population and economic activity than for the Northwest as a whole. The reason is that the region is a more valid geographic and economic entity than any of its parts. Probably the most important part of this latter effort would be the identification of subdivisions of the region where growth in population or economic activity or both should be encouraged and where they should be discouraged. The relationships between population, economic activity, and natural and artificial pollution control used in the E & E study could be useful in identifying such regional sub-areas. Also, there should be considerable attention devoted to the most desirable balance between metropolitan-urban, medium-urban, small-urban, and rural areas, both within the region and each subregion. In some instances, the need for encouraging the development of new or expanded towns and cities and new industrial centers may be identified. The President's message of March 10, 1971, included a number of proposals for reversing the migration from rural areas to big cities. Some differences in needs in different portions of the region were discussed in Chapter II D.

Another feature of the E & E study which (after further refinement) could be utilized by the Commission in the near future is the method for estimating a carrying capacity for various types of recreational land and setting tentative standards per capita for various forms of recreational activity.

Once the target goals for population, economic activity, and the intangible values for a region or subregion have been selected by popular consensus, techniques should be developed for determining the needs and the design of many of the subsidiary component systems such as water resource development, transportation, health, education, energy, recreation, industrial centers, and urban centers, so that they would be most compatible with the goals. Probably these techniques would entail additional information and the development of some new methods. Possibly the designs in most cases could be facilitated by a systems approach and the use of computers. A method for objectively weighing priorities also would be needed.

The most elaborate and extensive methods employed and efforts devoted to goal setting and plan preparation would prove futile unless the necessary systems and organizations for implementation also were developed and adopted. The proposed concept for goals establish ment is intended as only the first portion of the full process—the first three steps. The next part, after testing of the goals concept,—seven steps—should be the design and completion of the machinery for implementation of the plan.[39]

Full public participation in and acceptance of all stages of the goal setting, regional and subregional planning, and implementation of plans would be essential. As Michael Bowen, editor of Environmental Science and Technology, observes: "Getting rid of gross air and water pollution (and land spoilation) during the 70's will be child's play compared to arranging the social and political changes needed in the years in the 80's to bring undisciplined growth in population and industry under control." Economist Kenneth Boulding of the University of Colorado calls this the transition from the "cowboy economics" of unfettered growth to the planned orderly growth of "spaceship economics," the concept of man's dependence on a finite, enclosed life-support system known as earth. The carrying capacity concept occupies the middle ground between "progress at any price" and "preservation at any price." What better place to thoroughly test the concept than the Pacific Northwest, the land of the pioneers?

The new alternative approach to establishing long range, comprehensive, and well integrated planning goals outlined in this study is not intended to be a static process. Information from more detailed studies of each subregion is expected to result in some adjustments in regional planning objectives. Also, there may be new and proven developments in science and technology or new discoveries of resources or other new knowledge that permits an adjustment in long range goals of a region or subregion. Thus, a reassessment should occur periodically. It should be possible to devise systems that would keep the information current, to monitor all kinds of developments, the availability of resources, the effectiveness of pollution control, etc., and make necessary adjustments on a more or less automatic basis. This is the procedure in use for renewable resources such as forests and rangelands.

---

[39] This study is only a beginning. Testing of the concept and a thorough exploration and refinement of its many facets would require substantial input from universities, foundations, industrial entities, other research organizations, Federal, State and local governments, in addition to the Commission's continued efforts.

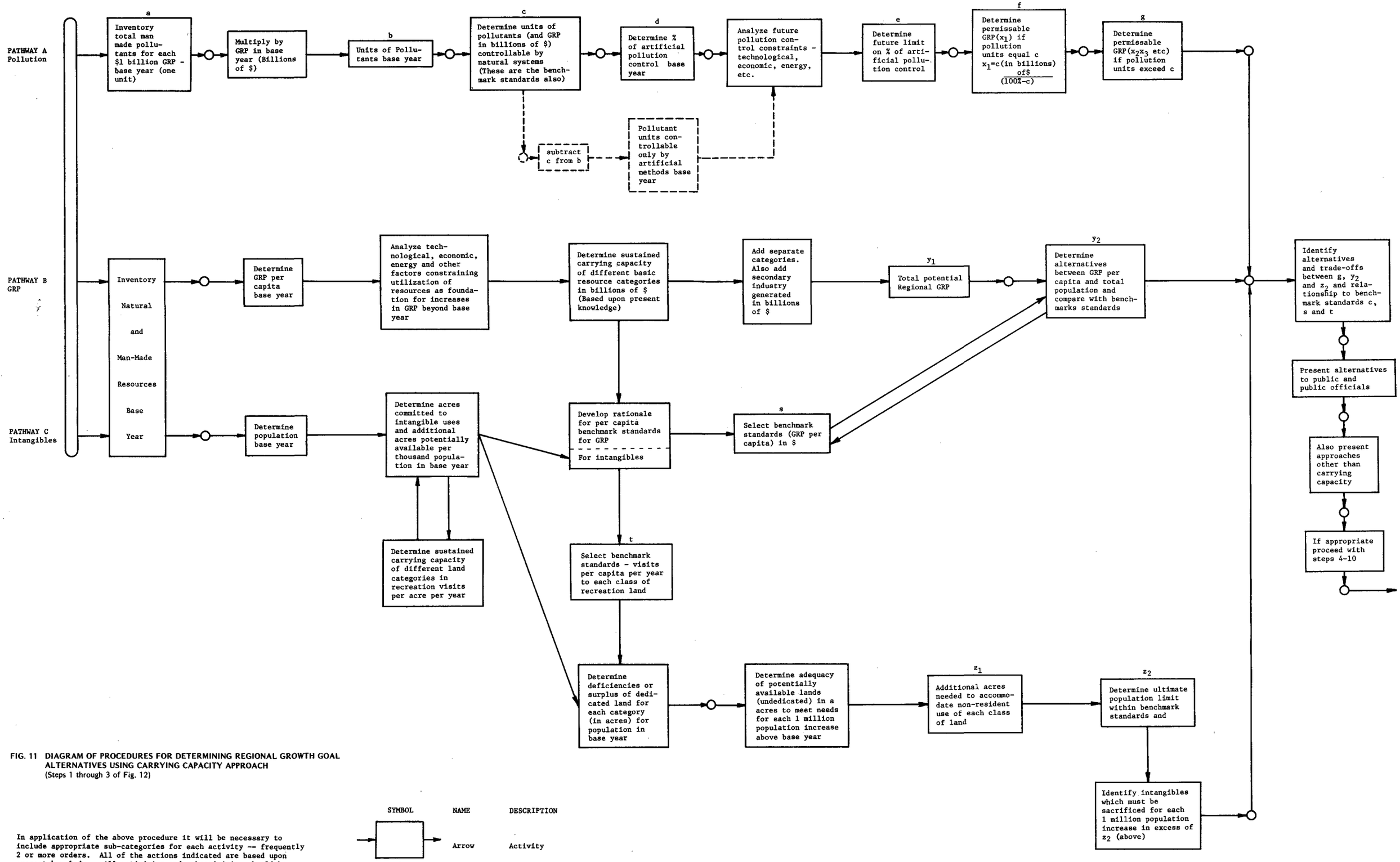

FIG. 11 DIAGRAM OF PROCEDURES FOR DETERMINING REGIONAL GROWTH GOAL ALTERNATIVES USING CARRYING CAPACITY APPROACH
(Steps 1 through 3 of Fig. 12)

In application of the above procedure it will be necessary to include appropriate sub-categories for each activity -- frequently 2 or more orders. All of the actions indicated are based upon present knowledge. All activities and subactivities should be monitored and new information gathered continuously. This new information should be translated as soon as possible into revision of the previous information and activity as outlined in Fig. 11.

SYMBOL	NAME	DESCRIPTION
→ □ →	Arrow	Activity
○	Nodes	Start or end of activity

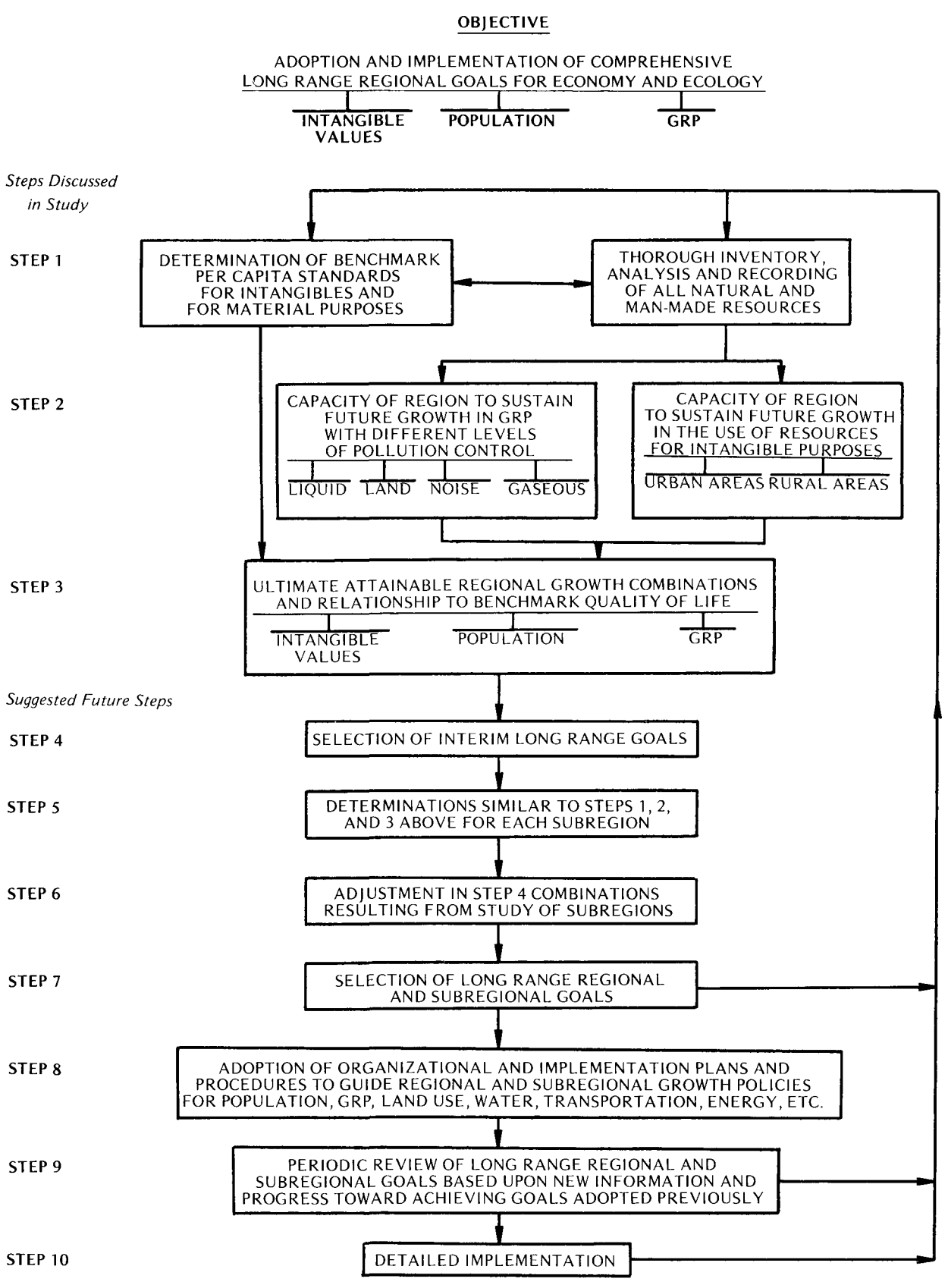

FIG. 12 DIAGRAM OF STEPS PROPOSED TO ADOPT AND IMPLEMENT A GROWTH POLICY WHICH COINCIDES WITH THE CAPACITY OF A REGION TO SUSTAIN HUMAN USE

Two diagrams have been prepared (Figure 11 and Figure 12) to explain the study methodology more concisely. Figure 11 is a flow chart of the first three steps of the 10 steps depicted in Figure 12. In Figure 11, three pathways are shown—pollution, gross regional product, and intangibles. Each of the three pathways identifies constraints which would limit potential growth in population or GRP. Any one of the three could prove to be the limiting factor.

In the Pacific Northwest example the limiting factor is Pathway A, Pollution. If pollution does not exceed benchmark standards the potential gross regional product could be $85 billion (9 million population with $9,500 in per capita share of GRP).

For Pathway B, GRP, the potential is identified only as X or Y (9 million-plus population with $9,500 in per capita share of GRP).

For Pathway C, Intangibles, there is no relationship identified with GRP but population should not exceed 10 million.

In Figure 12, all 10 steps identified in adopting and implementing a growth policy based upon carrying capacity principles are diagramed.

The carrying capacity approach is presented as a candidate new method for identifying long range goals for a region or other large geographic area. Other methods currently in use include:

1. Muddling through with each individual free to pursue his or her own goals and with little or no concern for collective long range goals.

2. Arbitrary limitations on population and economic growth through political action.

3. Historical trend projections with assumptions of one or more growth rates.

4. Scenarios depicting the consequences on the overall quality of life of the interaction of a number of variables over different time periods. (Carrying capacity may be considered as one scenario based on the achievement of "ecolibrium.")

Planning organizations should display, early in the planning process, the full array of alternatives and allow the public, through established socio-political channels, to choose the most desirable method or combination of methods for deciding upon long range goals.

This study purports to present only the case for using carrying capacity concepts (after needed testing) as one of the alternative methods for identifying long range regional goals. It speculates only briefly about the practical aspects of implementing the carrying capacity concept. It does not discuss in any detail the relative advantages and disadvantages of alternative methods for identifying long range goals.

We need to revitalize water planning by recognizing the interrelationships between land use and water use. A new basis is needed for water planning. In the past, water planning has tended to be based on projected economic and population trends. Water resource planners have tended to use projections of population and economic activity such as OBERS as synonymous with public goals. As a result, planning decisions have tended to become when, where, and how a project can be built to meet future needs. Projections have become self-fulfilling prophecies.

Such planning may have been appropriate in a period of territorial settlement, rapid population growth, and unquestioned economic expansion. However, we now need to consider the probability of a stable population and an expanded set of issues such as, pollution abatement and control, wild and scenic river designations, preservation of ecological and historic sites, open spaces and housing, and flood plain and estuarine protection. Land and water planning must be integrated and based on the carrying capacity of the region to satisfy certain economic and environmental needs within the area but also, if possible, to benefit people of other regions. Planning should become a positive force for desirable change rather than a reaction to uncontrolled growth.[40]

No longer should there be any qualitative difference between the goals of the economist and those of the ecologist. A vital humanism should inspire them both . . . it is time for the economist and ecologist to move out of the separate, cramped intellectual quarters they still inhabit, and take up residence together in a larger house of ideas—whose name might well be the House of Man.

Russell E. Train[41]
June 1972

---

[40] Fairchild, Warren D., Assistant Commissioner, U.S. Bureau of Reclamation, to Annual Conference of American Water Works Association, May 16, 1973, (appointed Director of the Water Resources Council in August 1973).

[41] Chairman of U.S. Delegation, before the United Nations Conference on the Human Environment, Stockholm, Sweden, June 1972.

CHAPTER VII

SELECTED BIBLIOGRAPHY

Allen, Durward L., "Planet Earth Under the Occupation," Keynote address to Izaak Walton League Annual Convention, July 1970.

"Natural Resources and the Cult of Expansion," The New York State Conservationist, December 1967–January 1968.

"Population, Resources, and the Great Complexity," Wildlife Management Institute, March 1969.

"Environmental Pollution: An Ecological Perspective," Presentation to Conservation Leaders' Forum, Cornell University, October 1969.

American Academy of Arts and Sciences, "Toward the Year 2000; Work in Progress," Daedalus, Summer 1967.

American Chemical Society, "Cleaning our Environment–The Chemical Basis for Action," ACS Special Issue Sales, Washington, D.C., 1969.

Battelle Memorial Institute, "The Pacific Northwest–A Study of Economic Growth in a Quality Environment," two volumes, December 1967.

Bonneville Power Administration, "Pacific Northwest Economic Base Study for Power Markets," Volume I, Summary, 1970; also Volume II, 13 Supporting Studies.

Boulding, K.E., "The Economics of the Coming Spaceship Earth," Henry Jarrett (ed.), a chapter in "Environmental Quality in a Growing Economy," Johns Hopkins Press, 1971.

"Environment and Economics," Wm. Murdoch (ed.), a chapter in "Environment," Sinauer Assoc., 1971.

Brubaker, Sterling, "To Live on Earth," a Resources of the Future publication, The Johns Hopkins Press, 1971.

Caldwell, Lynton K., "The Ecosystem as a Criterion for Public Land Policy," Natural Resources Journal, April 1970.

"Environment: A Challenge to Modern Society," Natural History Press, 1970.

Caldwell, William A.(ed.), "How to Save Urban America," (c) by the Regional Plan Assoc., Inc.; The New American Library Inc., March, 1973.

Chen, Kan, "A Macrosystem Analysis of the Human Environment," J. Environ. Sys., June 1971.

Clawson, Marion, "Suburban Land Conversion in the United States: An Economic and Governmental Process," a Resources for the Future publication, The Johns Hopkins Press, 1971.

Cole, Ansley J., "Man and His Environment," Science, October 9, 1970.

Commission on Population Growth and the American Future, Final Report March 1972, The New American Library, Inc., supported by 102 research papers. The research papers, in seven volumes, are available from the U.S. Government Printing Office:

Vol. I. Demographic and Social Aspects of Population Growth
Vol. II. Economic Aspects of Population Growth
Vol. III. Population, Resources and the Environment
Vol. IV. Governance and Population
Vol. V. Population Distribution and Policy
Vol. VI. Aspects of Population Growth Policy
Vol. VII. Statements Presented at Public Hearings

Committee on Resources and Man—Preston Cloud, Chairman, "Resources and Man," National Academy of Sciences, 1969, W.H. Freeman & Co.

Commoner, Barry, "The Closing Circle," Alfred Knopf, 1971.

Council on Environmental Quality, First, Second, & Third Annual Reports, U.S. Government Printing Office, August 1970; August 1971; August 1972.

Daly, Herman, an essay in "Patient Earth," ed. J. Harte and R.H. Socolow, Holt, Rinehart and Winston, 1971.

Darling, F. Fraser, and Milton, John P., "Future Environments of North America," Symposium sponsored by the Conservation Foundation, Natural History Press, 1966.

Edberg, Rolf, "On the Shred of a Cloud," University of Alabama Press, 1969.

Ehrlich and Ehrlich, "Population, Resources, Environment," W.H. Freeman & Co., 1970.

EPA, "Quality of Life Concept," also "Alternative Futures and Environmental Quality," 1973.

Ewald, William ed., "Environment and Change; The Next Fifty Years," commissioned by American Institute of Planners, Indiana University Press, Bloomington, 1968.

"Environment and Policy: The Next Fifty Years," Indiana University Press, Bloomington, 1968.

Gavor, Denis, "The Mature Society," Praeger, 1972.

Goldsmith, Edward, et al., "A Blueprint for Survival," The Ecologist, January 1972.

Greenwood, N.H., and Edwards, J.M.B., "Human Environments and Natural Systems," Duxbary Press, 1973.

Hardin, Garrett, "The Tragedy of the Commons," Science, Vol. 162, pp. 1243-1248, December 13, 1968, copyright.

"The Survival of Nations and Civilization," Science, Vol. 172, p. 1297, June 25, 1971.

Heller, Alfred, et al., "The California Tomorrow Plan," Revised Edition, Summer 1972 edition of Cry California. Also available from Wm. Kaufmann, Inc.

Hutchison, S. Blair, "Bringing Resource Conservation into the Main Stream of American Thought," Natural Resources Journal, October 1969.

Levine, H.D., "Human Ecology," Duxbury Press, 1973.

Maddox, John, "The Doomsday Syndrome," McGraw Hill, 1972.

McHarg, Ian, "Design With Nature," Natural History Press, 1969.

Mishan, E.J., "Technology and Growth: The Price We Pay," Praeger, 1970.

National Goals Research Staff, "Toward Balanced Growth: Quantity with Quality," U.S. Government Printing Office, July 1970.

Odum, Howard T., "Environment, Power and Society," Wiley Interscience, 1971.

Pacific Northwest River Basins Commission, "Comprehensive Framework Study of Water and Related Lands," Main Report and 16 Appendices, 1971.

Potter, Van Rensselaer, "Bioethics: Bridge to the Future," Prentice-Hall, 1971, Chapter 10.

President's Science Advisory Committee, "Restoring the Quality of Our Environment," Report of the Environmental Pollution Panel, U.S. Government Printing Office, 1965.

Ridgeway, James, "The Politics of Ecology," E.P. Dutton & Co., 1970.

SCEP (Report of Study of Critical Environmental Problems), "Man's Impact on the Global Environment," sponsored by the Massachusetts Institute of Technology, MIT Press, 1970.

Seckler, David W., & Barkley, Paul W., "Economic Growth and Environmental Decay," Harcourt Brace Jovanovich, Inc., 1972.

Spilhaus, Athelstan, "Ecolibrium," Retiring President's Address to AAAS, Science, February 18, 1972.

Tahoe Regional Planning Agency, "Proposed Regional Plan, Lake Tahoe Region, California-Nevada," May 1971.

Toffler, Alvin, "Future Shock," Random House, 1970.

Wagar, J. Alan, "Growth Versus the Quality of LIfe," Science, June 5, 1970.

Watt, K.E.F., Glass, H.R., et al., "Land Use, Energy, Agriculture and Decision Making," A Report to the National Science Foundation Office of Interdisciplinary Research, Grant No. G1-27, May 1971.

GLOSSARY OF KEY TERMS

Within the context employed in the "Ecology and the Economy" study.

Carrying Capacity (sustained yield): The achievement, and management in perpetuity, of annual or regular periodic outputs or other functions of the various renewable natural resources without permanently impairing long term productivity, ecosystem integrity or the quality of the land, air, and waters and their environmental values. Within the above limitations, the quantity and quality of outputs or other functions can be varied in accordance with the quality and intensity of the management and technology inputs. Similar to "steady state" or "ecolibrium." The latter is a term coined by Athelstan Spilhaus, 1971 President of AAAS (Science February 18, 1972).

Constant Dollar: The value of a dollar in terms of its purchasing power during a given base year. It discounts inflation or deflation. The ratios used in this study are as follows:

Year	Percentage Rate of Inflation	Dollar Value
1965	-o-	1.000
1966	2.6	.975
1967	2.4	.952
1968	3.5	.919
1969	4.2	.882
1970	5.1	.839
1971	2.8	.816

Example, $7,500 in constant 1965 dollars = $9,200 in 1971 dollars.

Ecology: The study of the relationships between humans and their physical environment including other forms of life. It includes the effects of the biotic component on the physical environment and vice versa.

Exponential Growth: Annual or periodic increases in a function or activity by either a fixed or variable rate (exponent). All increases are cumulative. Exponential growth in a geometric series results in increases by a fixed rate each year (or other time period). An example is compound interest at 7%. Other exponential growth may result in increases by a variable rate each year (or other time period). An example is the gross national product which may increase by 2% one year, 6% the next, etc.

Gross Product: The total value of goods and services produced in a given year according to the national income accounting system. For the nation, GNP is compiled annually by the U.S. Department of Commerce and appears in the annual report of the Council

mountains, valleys, and plains and to water bodies such as oceans, lakes, and rivers); and all associated forms of energy such as animals, hydro, solar, tidal, wind, organic fuels (other than fossil), and a portion of the geothermal.

Natural Resources-Non-renewable: All those not susceptible to management and utilization under sustained yield principles--principally minerals, both metallic and non-metallic. (Theoretically even these resources are susceptible to sustained yield management. The metallics, such as iron and copper, and some of the non-metallics, such as phosphates and limestone, could be recycled. Even fossil fuels could be recycled by using solar, geothermal, or nuclear energy to extract carbon dioxide from the atmosphere and convert it to carbon fuel. However, for the foreseeable future, only partial recycling of a limited number of minerals is expected to be feasible.)

Pacific Northwest: The drainage of the Columbia River in the United States plus coastal drainages of Oregon and Washington--a total of 173 million acres. It includes all of Washington; all of Oregon except the Klamath River drainage; all of Idaho except the Bear River drainage; and minor portions of Montana, Wyoming, Nevada, and Utah. See Figure 1.

Pollution: All forms of natural ecosystem degradation or environmental stress caused by man's activity (any by-products of human activity in excess of the amount assimilated by natural systems). It includes land spoliation; (examples are all types of mining, agriculture, forestry, road construction and industrial and urban construction practices which cause soil contamination or erosion, ugliness, disruption of wildlife habitat, or disharmony with the natural setting); reduction in water quality; (examples are all point and non-point sources of chemical, biological and suspended solid (soil particle) and thermal contaminants which reach surface or ground waters); reduction in air quality; (examples are all manner of emissions to the atmosphere which have either short term or long term adverse effects upon the health of humans or other forms of life, have disagreeable odors, reduce visibility or insolation or modify the climate inadvertently); or increased noise which is harmful to the physical or mental health of man and other forms of life.

In 1972 there were no agreed upon methods for measuring either the total amount of pollution or individual pollutants. However, the Environmental Protection Agency had begun to develop indices for some types of pollution.

Servant Machine: A term devised to represent the amount of goods and services (gross product) that an average person could produce in a year without modern powered equipment (exclusive of domestic animals). The value of this production is assumed to be $250 in constant 1965 dollars; it includes all the material benefits that flow from this production and all the detrimental effects (environmental stress).

Recreation Land Classes (Bureau of Outdoor Recreation)[42]: The recreation inventory of the

[42] From Appendix XIII, Recreation, Columbia-North Pacific Framework Study, 1972.

of Economic Advisors, and many other publications. There has been no universally accepted compilation of the gross product for the Pacific Northwest region. However, the total personal income is compiled. For the purposes of this study, personal income was assumed to be 79% of GRP, a ratio that historically has proven to be approximately correct for the nation as a whole. (As the carrying capacity concept is refined it may be desirable to use net product instead of gross product.)

Industries-Basic: Industries directly dependent upon the consumption, manufacture and use of renewable and non-renewable natural resources to produce goods or services that have a dollar value at the market place. In most cases these goods and services are suitable for both export or use within the region. They include the following major categories in the Pacific Northwest.

Based on Renewable Resources: Forest products, agricultural crops, recreation and tourism, commerical fisheries, and industrial activity based upon location.

Based on Non-renewable Resources: Mining and minerals.

Industries-Secondary (ancillary or non-basic): Industries generated by employment and income in basic industries. The goods or services produced have a dollar value at the market place but their use is generally intra-regional. However, to the extent the production exceeds the consumption in a region, they become basic industries. Examples are (a) contract construction of homes, industrial buildings, schools, highways, etc.; (b) transportation, communication, and utilities; (c) wholesale and retail trade; (d) finance, insurance, and real estate; (e) education; and (f) government and miscellaneous.

Industries Based upon Location: Industries which find it advantageous to maintain their location in the Pacific Northwest because of renewable natural resources in the form of geographic location on the Pacific rim; seaports and other transportation; abundant high quality water; relatively low cost hydroelectric power; a moderate climate; a continuous inflow of clean air off the Pacific Ocean; high quality land available for urban and industrial expansion; and open space and a high quality outdoor environment for the use and enjoyment of management and employees. Includes some industries frequently referred to as "footloose." The carrying capacity of northwest natural resources to maintain the "location" category of industry and the quality of life trade-offs involved are largely unexplored. The seven categories of industry involved are listed in Appendix 6.

Long Range Planning: Thirty years or more into the future.

Natural Resources-Renewable: Resources susceptible to management and utilization under sustained yield principles such as: all plant life (forests, grass, agricultural crops, phytoplankton, etc.); all animal life; water for all purposes, consumptive and non-consumptive; the land; the atmosphere, including local air quality; climate; physical setting (location in relationship to the foregoing resources and to landforms such as

land in the region is based on the 1964 Bureau of Outdoor Recreation survey. Public land recreation character was reported in six classes listed in the ORRRC report. Definitions and examples of each of the classes follow. Private lands and some public lands were not included in the inventory.

Class I – High Density Recreation Areas
Types of areas found in this class are often associated with urban populations and are usually oriented toward day-use activities. The key to classification is the intensity of use and development. Capacity per acre averages 3,000 recreation days annually and includes a wide range of activities such a playing games and sports, swimming (pool and lakes or beaches), and picnicking. Examples of Class I include the urban parks and playfields found in Seattle, Portland, Spokane, Boise, and other cities.

Class II – General Outdoor Recreation Areas
Areas included in this class are found in a wide variety of locations throughout the region. They are often non-urban in character and include man-made developments. Most developed non-urban camping areas, boat launching areas, winter sports areas, etc., are included. Many of the recreation sites located near reservoirs and lakes are in this class. Included also is the acreage of immediate buffer zones around the developed area. Annual capacity per acre is about 250 recreation days. Overnight and vacation use is often associated with these areas. Examples include portions of many county, state, and national parks, campgrounds in the national forests, and other public lands, and developed sites near reservoirs and lakes. Some of the lands have potential for development to Class I intensity.

Class III – Natural Environment Areas
Included in this category is the bulk of the national forests, parks, wildlife refuges, and other public lands. Developments are limited, with the primary uses including sightseeing, hiking, hunting, fishing, boating, canoeing, mountain climbing, and rock hounding. The annual use capacity is about one recreation day per acre. Some of the land in this class has the capability of becoming Class I or II by development of facilities. Some has the potential for shifts to Class IV, V, or VI depending on management direction.

Class IV – Outstanding Natural Areas
Areas in this category contain the superlative scenic, geologic, and natural features of the region such as mountain ranges, canyons, waterfalls, lava flows and caves, unusual timber stands, scenic rivers, and other natural phenomena. Examples include the Columbia Gorge, Salmon and Snake River Canyons, Lost Forest in Oregon, Bruneau and St. Anthony Sand Dunes, portions of the Cascade Range, parts of the Skagit and Rogue Rivers, the Chetco Redwoods, and portions of Yellowstone National Park. Development includes only those facilities necessary to protect the natural features. Activities include sightseeing, outdoor photography, and study of the natural features. Capacity varies from 20 to 50 recreation days per acre depending upon the accessibility and the type of resource.

Class V – Primitive Areas
Areas in this class contain remote lands and designated wildernesses. The region contains about 40 percent of the National Wilderness System. Examples are the Bob Marshall, Pasayten, Selway-Bitterroot, Anaconda-Pintlar, Three Sisters, and Mt.Jefferson Wildernesses and Idaho, Sawtooth, Salmon River Breaks Primitive Areas. Man-made developments are minimized, consisting primarily of foot and horseback trails.

Major uses are hiking, sightseeing, photographing, fishing, hunting, horseback riding, and mountain climbing. Boating is restricted to hand-propelled craft or float boats and rafts. Depending on the size of the area, use of less than one recreation day per acre annually would be optimum.

Class VI – Historic and Cultural Sites
Sites in this class include those associated with the history, tradition, or cultural heritage of national, state, or local interest and are of enough significance to merit preservation or restoration. Sightseeing, outdoor photography, and study of history and prehistory are the primary uses. Since the sites are usually small in size, the annual use per acre may be similar to Class I sites when developed. Access, parking, and interpretation facilities are the primary developments associated with such sites. Examples found in the region include Fort Clatsop, Fort Vancouver, and Marcus Whitman national areas; state heritage sites; national historic sites; state areas such as Champoeg State Park in Oregon, Fort Columbia in Washington, Fort Casey, Washington; Cataldo Mission in Idaho, and numerous other memorials.

Appendix 2

POINTS OF VIEW ABOUT OVERCROWDING

Although the human animal is much more variable and adaptive than the lower species, many of the world's scientists contend that we share more behavorial traits than are commonly recognized.[43] For example, John Calhoun of the National Institute of Mental Health has conducted a long series of studies of colonies of Norway rats, carefully maintained at an abnormally high density level. The effects were strikingly similar to those found in crowded city slums; a progressive rise in aggression, random violence, sexual aberration, neglect of nest building, infant mortality, stunted growth, and pathological or psychopathic diseases related to high stress. The onset of such behavior is sharply, even mathematically determined by the number of bodies occupying the available space. Recent experimental work with humans provides evidence that crowding may increase aggressiveness in males.[44]

> *Man will survive as a species for one reason: He can adapt to almost anything. I am sure we can adapt to the destructive effects of our power-intoxicated technology, and of our ungoverned population growth, to the dirt, pollution and noise of a New York or Tokyo; and this is the tragedy. It is not man the ecological crisis threatens to destroy but the quality of human life.*
>
> *"Mere Survival is not Enough for Man,"*
> *Rene Dubos, Life, July 24, 1970*[45]

In his article "Science Takes a Closer Look at Man," published in Fortune, January 1970, Lawrence Lessing concludes that: "No animal population has yet been found to endure a continuous increase in numbers without ultimately suffering collapse, disorder and disaster . . . the present implosion of largely rural populations in run-down sections of central cities (the nation's largest and most congested cities) has all the earmarks of population buildup and subsequent crash in the animal world."[46] Wildlife authorities agree that all wild animal populations eventually reach a balance with their environment short of the available food supply.

Many authorities agree that man's well-being also suffers under conditions of overcrowding and lack of access to natural surroundings. He is inseparably linked with the life supporting systems and cycles of air, water,,soil, plants, and animals. In one way or another he must comply with the immutable basic laws of nature that govern all life on spaceship earth. The end result of artificially propping up an unnatural and increasingly unbalanced condition is a violent adjustment. The uncertainty lies in accurately determining what is

---

[43] "The Territorial Imperative" and "The Social Contract" by Robert Ardrey: "On Aggression" by Konrad Lorenz; "The Naked Ape" and "The Human Zoo" by Desmond Morris; "So Human an Animal" by Rene Dubos.

[44] Freedman, J.L.; Levy, A.; Price, J.; Welte, R.; Katz, M.; Ehrlich, Paul, in preparation. Also see Science, Vol. 171, No. 3977, pg. 1215.

[45] "Mere Survival is not Enough for Man," Rene Dubos, *Life*, July 24, 1970. Time, Life, Inc., Rockefeller Center, New York, N.Y., 10020.

[46] Also see "Control of Population" by Robert Ardrey, *Life*, March 1970, and "Population, Resources, Environment," Chapter 6, by Paul R. Ehrlich and Anne H. Ehrlich, W.H. Freeman Co. (1970).

balanced and unbalanced. If population is not limited and better distributed, we shall be forced to make distasteful adjustments in life styles.

> *Unless a favorable balance of population and resources is achieved with a minimum of delay, there is in prospect a Dark Age of human misery, famine, under-education and unrest which could generate growing panic, exploding into wars fought to appropriate the dwindling means of survival.*
>
> *Joint paper by Sir Julian Huxley and 37 other Nobel Prize winners.*

Other authorities maintain that there is still plenty of open space to be developed. They emphasize that more (not less) science and technology and the use of energy will be necessary both to correct the abuses of the past and build a better environment of the future. They feel that the prophets of gloom and doom have unnecessarily exaggerated the seriousness of our environmental situation and incorrectly given the impression that it is hopeless.[47] For example, they point to the fact that fertility rates are declining world-wide. In their opinion, it is nonsense to dream of returning to some mythical utopia of the past. They cite Lake Erie as an example of a water body that is far from "dead" as has been stated over and over in the popular press, but one which can be reclaimed—in the same way Lake Washington was rejuvenated. Another example is the false alarm that was raised about the alleged threat to global supplies of atmospheric oxygen due to man's activities. Yet another is what appears to be exaggeration of the dangers of phosphate detergents,[48] or the imminence of global famine.

Dr. Philip Handler, President of the National Academy of Sciences in 1971, attempts to place the basic conflict between ecology and economy in perspective in his article "Exaggeration: The Other Pollution Peril," in the April 1971 issue of *Nation's Business*. He concludes his article:

> *Those who, in my view, exaggerate the nature or magnitude of the pollution problem nevertheless are on the side of the angels. They want a clean, healthy United States. To argue with this is nonsense. And they have generated a climate in which effective action should be possible.*
>
> *Our problems are to accurately assess environmental hazards, learn the processes which are involved, and reach realistic public decisions about their management.*
>
> *Public Panic is as completely unwarranted as concern is justified.*[49]

---

[47] Maddox, John, "The Doomsday Syndrome," McGraw-Hill, 1972.

[48] Stopping phosphates in the ecosystem can be equally as damaging as introducing too much. Phosphates provide an essential component for the transfer of energy in all biological systems. Dr. Beatrice Willard, Member, Council on Environmental Quality, February 1973.

[49] "Exaggeration: The Other Pollution Peril," Philip Handler, *Nations Business*, April 1971. Chamber of Commerce of the United States, 1615 H Street, N.W., Washington, D.C., 20006.

Table 6 - Concentrations of Population and Industry - Selected Nations of the World - 1970
(Assuming no pollution control - ranked in descending order)

(1) Nation	(2) Acres[1] (Thousands)	(3) Population[1] (Thousands)	(4) Acres per Person	(5) Per Capita[1] Share GNP in 1967	(6) Per Capita[2] GNP Divided by $250	(7) Servant Machines Per Capita	(8) Acres per[3] Person and Equivalents
1. Netherlands	8,256	13,000	0.64	$ 1,444	5.78	4.78	0.11
2. West Germany	59,412	55,600	1.01	1,663	6.65	5.65	0.15
3. United Kingdom	60,295	56,000	1.08	1,615	6.46	5.46	0.17
4. Japan	91,055	103,500	0.88	950	3.80	2.80	0.23
5. United States	2,273,343	204,800	11.10	3,486	13.94	12.94	0.80
6. Sweden	111,098	8,000	13.89	2,375	9.50	8.50	1.46
7. India	807,422	544,600	1.46	250[4]	1.00	0	1.46
8. Pacific N.W.	175,625	6,311[5]	27.83	3,933[6]	15.73[6]	14.73	1.77
9. China (Mainland)	2,404,792	759,600	3.17	250[4]	1.00	0	3.17
10. USSR	5,533,343	242,600	22.81	827	3.31	2.31	6.89
11. Canada	2,278,523	21,400	106.47	2,261	9.04	8.04	11.77
12. Australia	1,899,946	12,500	152.00	1,872	7.49	6.49	20.29

[1] Sources: Economic Almanac, by National Industrial Conference Board, McMillan Co., New York; Population Reference Bureau, Washington, D.C. Per Capita GNP expressed in 1965 dollars.

[2] The total, minus 1, equals the number of "servant machines" per person.

[3] Assuming that an average person, unaided by powered machinery, would produce in one year goods and services worth $250 and that this production comprises his personal impact upon the environment—that each additional $250 in per capita production in any one nation results from the use of powered machinery (servant machines)—column 4 divided by column 6. It is assumed that the impact per person will remain constant at $250 regardless of the GP level. However, the impact per servant machine varies in inverse proportion to the percentage of pollution control: Impact = 100% less % of pollution control. The percentage of pollution control in each nation is unknown.

[4] To conform with minimum—actual share was $90.

[5] Preliminary 1970 Census.

[6] Share of Gross Regional Product, 1967—assuming per capita income equals 79% of per capita share of GRP. SOURCE: U.S. Dept. of Commerce, 1969 Business Statistics; and Pacific Northwest Economic Base Study - Recreation.

Table 7 - Concentrations of Population and Industry
Selected Nations of the World - Projections to 1980
(Assuming no pollution control - ranked in descending order)

(1) Nation	(2) Population[1] (Thousands)	(3) Acres per Person	(4) Per Capita[2] Share GNP 1965 Dollars	(5) Per Capita GNP Divided by $250	(6) Servant Machines Per Capita	(7) Acres per Person and Equivalents
1. Netherlands	14,500	0.57	2,380	9.52	8.52	0.06
2. Japan	116,300	0.78	3,380	13.52	12.52	0.06
3. West Germany	61,100	0.97	2,930	11.72	10.72	0.08
4. United Kingdom	59,600	1.01	1,920	7.68	6.68	0.13
5. United States	235,200	9.66	5,120	20.48	19.48	0.47
6. Sweden	8,600	12.92	3,750	15.00	14.00	0.86
7. India	717,400	1.13	250[3]	1.0	0	1.13
8. Pacific Northwest	7,290	24.10	5,100	20.40	19.40	1.18
9. China (Mainland)	893,900	2.69	250[3]	1.0	0	2.69
10. USSR	270,600	20.45	1,080[4]	4.32	3.32	4.73
11. Canada	25,300	90.06	3,660	14.64	13.64	6.15
12. Australia	15,400	123.37	3,030[4]	12.12	11.12	10.18

[1] From United Nations Population Division Working Paper No. 30, December 1969 (Medium Variant).

[2] Source: The Growth of Output 1960-1980 Working Paper No. 2, The Organization for Economic Cooperation and Development, Paris, France 1970.

[3] To conform with minimum; actual share would be less, probably not exceeding $100.

[4] Estimated.

Appendix 3

PRELIMINARY MEASUREMENT OF ENVIRONMENTAL IMPACT

A very rough measure of the environmental impact or stress resulting from a combination of population pressures and economic activity in selected nations of the world is depicted in Table 6, Column B, for 1970 and Table 7, Column 7, for 1980. However, the ranking is not necessarily an indicator of present desirability as a place to live. A more accurate measure of environmental impact would require additional information such as the control of liquid, solid and gaseous wastes and the distribution of income in each nation. Also it would be necessary to include other factors such as acreage and quality of habitable land, present distribution of population and industry and differences in climate and topography. Unfortunately, such information presently is unavailable. Consequently, the information presented in the two tables is a necessary first step but has only limited utility in measuring the full environmental impact of population and economic activity in the selected nations. The material standard of living is shown in Column 5 of Table 6 and Column 4 of Table 7. No attempt is made in Tables 6 and 7 to assess the trade-offs between GNP per capita and environmental impact per capita.

The fact that the nation with the most concentrated population and industry in the world in 1970 (the Netherlands) has been able to maintain a fairly good quality environment is a tribute to the discipline and hard work of its citizens over centuries, to intensive land use planning, to a high degree of pollution control, and to the importation of a high percentage of its food and raw materials.[50] In other words they have reduced considerably the damage caused by each servant machine. Although people in the Netherlands appear to have made a sustainable accommodation with their environment, the evidence strongly suggests that the nation is too densely populated for optimum livability. One evidence is the fact that the Netherlands encourages out-migration. Another is an October 12, 1968, report by columnist Granville Wilson that in Britain, which is slightly less congested than the Netherlands, "An overwhelming majority of the members of the British Institute of Biology believe that there are already too many people in Britain." This view is reinforced in the document "A Blueprint for Survival," published in the January 1972 issue of *The Ecologist* and supported by 33 of Great Britain's leading scientists. They suggest stabilizing the population at 30 million—half the 1972 level.

Projections to the year 1980 reveal that nations with the highest per capita share of gross product and a high concentration of population and industry in 1970 would have higher levels—both in absolute increases and in increases relative to underdeveloped and underpopulated nations (Table 7).

---

[50] Strong, Ann Louise, "Planned Urban Environments," Chapter IV, "The Netherlands—Too Many People—Too Little Space," The Johns Hopkins Press, 1971.

Brubaker, Sterling, "To Live on Earth," a Resources for the Future publication, The Johns Hopkins Press, 1972.

Odum, Eugene P., "Optimum Population and Environment: A Georgian Microcosm," Current History, June 1970.

Ridker, Ronald G., Ed., "Population, Resources, and the Environment," Part II, "Impact of Population Growth," p. 374, U.S. Government Printing Office, 19720-479-888.

If the projections shown in Table 7 prove to be correct, all the nations listed would become more "congested" by 1980, from 30 percent to 100 percent. However, the relative ranking as far as environmental impact is concerned would remain the same with one exception. Japan is projected to move from the fourth highest environmental stress in 1965 to a tie for first with the Netherlands, discounting the modifying effect of pollution controls. It is doubtful that significant pollution control occurs (or should be expected) until per capita share of gross product has advanced to at least $1,500 (5 servant machines per capita). It is unlikely that a high percentage of artificial pollution control (70% or more) can be attained without a relatively high per capita income (perhaps $5,000). It appears that the greatest environmental stress results from economic activity in the industrialized nations and from population in the undeveloped nations.

Appendix 4

STANDARDS FOR APPORTIONMENT OF AVERAGE ANNUAL INCOME UNDER BENCHMARK QUALITY OF LIFE CONDITIONS

The chief characteristics and average annual costs per capita of each of 15 component parts which make up the quality of life selected as a benchmark are discussed below. All items include maintenance and amortization. Actual incomes would vary widely from the $7,500 average, similar to the pattern of the past, but the lowest bracket should be above what is presently considered the poverty level. In other words this study assumes no major shift in income distribution. **The amounts indicated for the 15 categories are suggested lifetime averages in 1965 dollars. An "acceptable" level could be less or more. The first 14 categories include their proportionate share of government expenditures.** However the bulk of such expenditures including those for the intangibles would represent internalized costs of production. **Emphasis upon particular items would vary widely between individuals and groups. Due to the higher average income the apportionment varies considerably from actual average apportionments in 1960 or 1965.** Totals are summarized in Table 2.

1. **Food:**[51] A high quality, well balanced diet at an average cost of $960 per annum.

2. **Clothing:** Ample for all citizens for all climatic conditions in the area at a cost of about $450 per annum (estimated). According to the Bureau of Labor Statistics, this is slightly above the average in 1970 for a member of a family of 4 with a family income of $16,000.

3. **Housing:** An average of not less than 300 sq. ft. of fully modern housing per capita, with a variety adequate to satisfy all effective demand. Includes utilities, furnishing, equipment and operations, and rentals during trips away from home. There is no consensus concerning the optimum urban density, but several authorities recommend 1/8 to 1/2 acre per capita within the boundaries of any urban complex (including residences, business, industry, transportation, open space, etc.)[52] Total cost about $1,200 per annum (estimated). According to the Bureau of Labor Statistics, this figure is about $400 above the expenditure in 1970 per member of a family of 4 with a family income of $16,000.

4. **Transportation:** (Includes highways, airports, railroads, etc.) Efficient and dependable ground and air transportation totaling an average of 9,000 miles per year per capita

---

[51] Families with incomes greater than $15,000 spend around 12 percent for food, including 30 percent for meals away from home. Stephen Hiemstra in the 1969 Yearbook of Agriculture, *Food for All of Us.* In 1965 average per capita expenditure for food in the Western States was $594.

[52] Most American cities presently have higher population densities. For example, a 1955 study of 28 American cities of less than 50,000 population revealed an average density of 0.10 acre per capita. This compares to 0.14 acre per capita for similar cities in Oregon. According to the Columbia Region Association of Governments, the Portland urban area in Oregon, with an estimated 1970 population of 769,000 and an area of 243,600 acres, averaged 0.31 acre per capita.

for transportation with an estimated average division as follows:

Private—ground, air or water—4,000 miles @ 10-1/2¢ = $420
Public—ground and water—2,500 miles @ 4¢ = $100
Public—air—2,500 miles @ 7¢ = $175

Commuting time in an urban area should not exceed one hour per day. Total cost about $700 per annum.

5. **Health:** Fully adequate medical skills and facilities to implement both a complete and up-to-date disease prevention program as well as treatment for every individual. The average person should be in good health at least 95 percent of the time and be free of the threat of persistent accumulative substances such as DDT, mercury, and radioactivity. Cost about $320 per year per capita (estimated).

6. **Education:**[53] Fully adequate skills and facilities to provide everyone an opportunity for an education commensurate with his or her capacity. This probably would average close to two years of college or vocational training or its equivalent, plus continuing education for every person at an average cost of $380 per capita.

7. **Clean Air:**[54] Visibility at least 30 miles during 90 percent of all clear days when relative humidity is less than 70 percent. Also, all invisible contaminants such as carbon monoxide and lead compounds would be within tolerable levels. Cost about $150 per annum.

8. **Clean Water:**[54] All lakes and free flowing water or impoundments on rivers or streams sufficiently free of biological, chemical, or suspended solid contaminants to be esthetically pleasing, safe for swimming, and a good habitat for fish and other aquatic life. Cost about $160 per person per annum.

9. **Solid Waste Disposal:**[54] All solid waste would be either recycled or permanently disposed of in a manner that results in no pollution, visual or otherwise. Cost about $110 per person per annum.

10. **Quietness:**[55] In industrial areas background noise of not more than 70 decibels dB(A) outside and 50 decibels dB(A) inside during working hours; in residential areas not more than 45 decibels dB(A) during the daytime and 35 decibels dB(A) at night. Standards for other areas and for noise peaks in proportion. Cost (mostly by reducing noise at its source) about $160 per capita per annum (estimated).

---

[53] Based upon $15,000 for 14 years of formal education plus $200 per year or $12,000 for continuing education.

[54] For derivation see Appendix 6.

[55] "Noise Pollution," Extension Circular 807, Oregon State University, May 1972.
Miller, Stanton, "Noise—Fourth Form of Pollution," Environmental Science and Technology, September 1970.
"The Balance," Bureau of Outdoor Recreation, Mid-Continent Region, USDI, April 14, 1970.
Beaton, John L., and Bourget, Louis, "Can Noise Radiation from Highways be Reduced by Design?," California Division of Highways.

11. **Attractive Design, Landscaping, Natural Scenic Beauty**: One of the most neglected aspects of our urban and industrial development. All residences, industries, businesses, utilities, transportation facilities, and other works or land uses of man designed, constructed (or developed or preserved), and maintained to result in freedom from monotony, and harmony with the natural setting and natural ecology. Visual pollution such as junkyards, offensive billboards, and power lines would be avoided. Cost about $130 per person per annum (estimated).

12. **Recreation and Entertainment**: The acreage requirements for optimum outdoor recreation and open space are large. Since the land potentially available for such purposes is fixed, it appears to impose constraints upon the regional population that can be accommodated at optimum livability levels. These constraints are discussed in Chapter IV C and Appendix 6 B.

    Adequate facilities and opportunities both urban and rural, (including sports, theatre, hunting, fishing, nature study, etc.), to provide a minimum of 1-1/2 occasions involving active participation and 1 occasion as a spectator or sightseer per week per person. Estimated average cost per occasion (or visit) is $3, excluding transportation costs, or a total of $400 per person per annum.

13. **Open Space**: Dedicated public parks, recreation areas, and undeveloped land in forests, grassland, or other vegetation should total at least 10 to 15 percent of all urban areas. Rural recreation areas include scenic or recreation rivers, scenic roadsides, wilderness areas, multiple use areas, wildlife management areas, etc.

    Benchmark standards are as follows:

    Acres per Thousand Population

Total Within	1 Mile[56]	13.5
Total Within	5 Miles[56]	17.5
Total Within	50 Miles[56]	35.5
Total Within	500 Miles[57]	15,550

    Cost $320 per capita per annum (estimated—mostly maintenance costs and land acquisition costs in or near urban areas. If 60 percent of the region were not already in public ownership, costs would be substantially higher).

14. **Savings, Contributions, Insurance, and Miscellaneous**: The estimate is about 7-1/2 percent or $560 per person per year.

15. **Government (Federal, State, and Local)**: All of the national security, international activities, and the coordination, research, public safety, law and order, resource management, and other duties and responsibilities of government, except the 14 categories listed above.

---

[56] Standards of the National Recreation and Parks Association and the Bureau of Outdoor Recreation (1967).

[57] See Table 4.

Government expenditures for the 14 categories have been apportioned among them. In 1960 the apportionment used was 32 percent of the Federal budget; 88 percent of the State government budget; and 83 percent of the local government budget. The apportionment of government expenditures under conditions of optimum livability assumes no world wars and the diversion of a substantial percentage of the present U.S. budget from defense and space to urban affairs, natural resources and environment (including science and technology components for each). An optimum environment can be achieved only through comprehensive long-range planning, including a thorough study and analysis of all resources—both man-made and natural. This planning can be implemented only by an educated and informed citizenry guided and directed by equally qualified government employees at all levels. The optimum cost would be about 20 percent of the total average income of $7,500 per capita or $1,500. This percentage is roughly the same as in 1970 for a family of four with an annual income of $30,000.

ILLUSTRATION OF POSSIBLE METHOD FOR SHOWING RELATIONSHIP BETWEEN THE "HIERARCHY OF HUMAN NEEDS" (Fig. 6) AND "AVERAGE APPORTIONMENT OF INCOME UNDER BENCHMARK QUALITY OF LIFE (Table 2)

Means to Satisfy Needs (Average Annual Per Capita Budget)

HUMAN NEEDS		1 FOOD	2 CLOTHING	3 HOUSING	4 TRANSPORTATION	5 HEALTH	6 EDUCATION	7 CLEAN AIR	8 CLEAN WATER	9 SOLID WASTE DISPOSAL	10 QUIET	11 ATTRACTIVE SURROUNDINGS	12 RECREATION	13 OPEN SPACE	14 SAVINGS, MISC.	15 GOVERNMENT (Except 14 items)	16 TOTALS
1. PHYSIOLOGICAL	%	70	50	50	30	50	10	20	20	20	25	10	10	10			28
	$	672	225	600	210	160	38	30	32	22	40	13	40	32			2114
2. SECURITY	%			15	15	20	30	10		10	10			20		65	21
	$			180	105	64	114	15		11	16			64		975	1544
3. SOCIAL	%	20	20	15	20	10	15	20	30	30	25	20	30	15	30	10	18
	$	192	90	180	140	32	57	30	48	33	40	26	120	48	168	150	1354
4. EGO	%	10	20	10	15	10	15	20	20	30	20	20	30	15	30	10	15
	$	96	90	120	105	32	57	30	32	33	32	26	120	48	168	150	1139
5. SELF FULFILLMENT	%		10	10	20	10	30	30	30	10	20	30	30	40	40	15	18
	$		45	120	140	32	114	45	48	11	32	65	120	128	224	225	1349
6 TOTALS	%	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	$	960	450	1200	700	320	380	150	160	110	160	130	400	320	560	1500	7500

Figures used represent preliminary subjective estimates of the principal author.

Appendix 6

DETERMINATION OF RESOURCE CARRYING CAPACITY FOR MATERIAL PURPOSES AND FOR INTANGIBLE PURPOSES

A. Resource Use–Material Purposes

The products derived from the utilization of natural resources for material purposes have a dollar value at the market place. They include both the "commodity" and "non-commodity" goods and services that comprise the gross product. They are based upon the consumption, manufacture, and use of natural resources. For purposes of this study, it is assumed that the basic resources which, directly or indirectly, provide the foundation for the production of all goods and services are divided into two main categories–renewable and nonrenewable. The basic industries in turn generate ancillary or secondary industries.[58] (See definitions in Glossary, Appendix I.) The total gross regional product in 1965 was about $20.4 billion.[59] The technique for estimating potential is summarized in Table 3 and Figure 11.

The quality of planning for and management of both the use and removal of basic resources affects the efficiency of resource utilization. In this paper, the assumption is made that increases in gross product above 1965 levels will be accompanied by measures that will result in a minimum of waste of natural resources. However, with a more sophisticated approach, high quality resource planning and management should not be taken for granted. Instead, it should be depicted as a variable which affects the sustainable levels of population, gross product and intangible values.

1. Renewable

a. Sustained Production Potential of Commercial Forest Land

In the Pacific Northwest there are 70.2 million acres of commercial forest land, 14% of the nation's total. It is 40% of all land in the region. In 1965, the total forest products industry consumed raw material at the rate of 54 cu. ft. per acre, or a total of 3.8 billion cu. ft. This is projected to increase to 66 cu. ft. per acre in 2020 for a total of 4.5 billion cu. ft. Based on estimates from Table 2 of Wall's research paper (PNW-84), the potential annual growth capacity of the forest land could approach 90 cu. ft. per acre.[60] This assumes full stocking, full utilization, and all known cultural measures to take advantage of soil productivity on all ownerships. If this does occur, consumption could be supported at a rate of about 6.1 billion cu. ft. per year on 68.2 million acres (20% of the potential for the nation).

---

[58] Battelle Northwest–Economic Growth in a Quality Environment, 1967, Vol. II, Chapter 4.

[59] For derivation, see Table 6.

[60] Wall, Brian R., "Projected Developments of the Timber Economy of the Columbia-North Pacific Region," Pacific Northwest Forest and Range Experiment Station Research Paper NPW-84 (1969).

According to the Department of Commerce Census of Manufacturers, the lumber and wood products and paper and allied products industries contributed $1,936 million to the regional product in 1967. A comparable figure is not available for 1965, but was approximately 15% less, or $1,670 million. The potential production volume is about 1.6 times the 1965 level. A greater percentage of local manufacturing and increases in the relative value of forest products used for building construction potentially could add an additional 25% in value or an eventual total of $3.34 billion per year (200% of the 1965 value). However, such intensive forest management and utilization would require equally intensive measures to prevent air and water pollution and to preserve scenic beauty and outdoor recreation opportunities on commercial forest land.

b. Sustained Production Potential of Agricultural Land

About 20.8 million acres, or 12 percent of the land area of the Pacific Northwest Region, was used for crop production in 1966. About 7,130,000 acres or 34 percent of all cropland was irrigated. Total cropland has been projected at 21.6 million acres in 2020. However, a large shift of dry cropland to irrigation is projected to occur by 2020 so that 13.1 million acres or 61 percent of all cropland would be irrigated.[61]

In 1964, the value of agricultural production in the Region was estimated at about $1,558 million of which $949 million or 61 percent was value of crop production.[62] By 2020, projected value of production at constant prices would be more than doubled, or $3,888 million. Crop sales would account for a slightly larger portion (64 percent) of the total.

Projected increases in crop and livestock production are associated in large measure with the projected increase in irrigation water use for agriculture. The adoption of improved technology also would increase markedly per unit yields and production of crops and livestock. For example, with 1964 as a base, indexes of yields in 2020 were projected on irrigated land as barley 186, alfalfa 186, potatoes 192, and sugar beets 159. Yields of some fruits on irrigated land were projected to increase 3 or 4 times by 2020.

About 36,155,800 acres, or 14.6 million acres more than the projected 2020 total, have been classified as suitable for crop production in the Pacific Northwest Region ultimately.[63] Possibly the 15,000,000 acres "suitable" but not now used for cropland are potentially somewhat less productive than present cropland, and irrigation likely would be more costly. But these estimates show a substantial land base available in the Region beyond preliminary estimated needs by 2020, including irrigation of a large portion of 8,000,000 acres of present cropland that still would be nonirrigated by 2020. Large additional quantities of irrigation water would be needed to achieve this level of cropland production. If the flow of the

---

[61] Projections to 2020 in this section are based on results of Columbia-North Pacific Type I Study, Water Resources Council.

[62] Appendix VI, Economic Base and Projections, Columbia-North Pacific Framework Study. 1970.

[63] Appendix VIII, Land Measures and Watershed Protection, Columbia-North Pacific Framework Study. 1969.

Columbia River at the Canadian border is not diminished below the current available flow (43 million acre ft.), there is sufficient water to supply irrigation water for the entire 33 million acres of potentially irrigable land in addition to the needs for industries, cities, navigation, fish, wildlife, recreation, power, and water quality. However, such irrigation would require high pump lifts and a major redistribution of available water supplies.[64]

The projected value of production from crops and livestock in 2020 averages about $180 per acre of cropland, a large portion irrigated; the value of livestock production includes substantial quantities of range grass used as forage. If the $180 average is applied to 36 million acres, a gross value product from agriculture would be $6,480 million; this estimate, of course, assumes constant prices and outputs per unit at the 2020 projected level.

In 1963, value added from manufacturing food and kindred products was about $745 million.[65] In Oregon and Washington, the value of this activity was around 15 percent of all manufacturing. Nearly 59,000 workers were employed in 1960 in this sector of the regional economy. This industry is projected to increase to three times its present size by 2020 (an overall index of 302 with base year 1963) or to a total of $2,255 million. If we assume that this figure represents the full potential value added from processing agricultural crops, the total potential economic impact would be $6,480 million plus $2,255 million or a total of $8,735 million each year. Since this figure assumes constant prices per acre and a constant value added factor, both at the projected 2020 level, it may not reflect the ultimate maximum carrying capacity. On the other hand, some of the limitations on future improvements in agricultural production through technology are discussed by Prof. Michael J. Perelman in the article "Farming with Petroleum" in the October, 1972 issue of *Environment.*

c. Sustained Production Potential of Recreation Land

In the Pacific Northwest there are about 150 million acres of land and 2.5 million acres of inland surface waters available for recreation use. This is about 15 percent of the available recreation land and 40 percent of the surface water in the nation, excluding Alaska. The scenery, fish and wildlife, wild and scenic rivers and historical areas are among the most outstanding in the nation. Except in the Puget Sound and Willamette Valley areas, the region is still sparsely settled and water and air are relatively unpolluted. In 1965 tourist expenditures in the Pacific Northwest totaled $900 million, 37 percent by out-of-region visitors. Expenditures are expected to increase to $4.6 billion by the year 2000.

In 1964 there were about 195 million recreation visits. Each visit resulted in an expenditure of about $5. The estimate in the Recreation Appendix for the Columbia-North Pacific Region Comprehensive Framework Study is that the carrying capacity of the Pacific Northwest recreation land with present existing facilities is 212.5 million recreation days annually. With added facilities, this could be increased to an ultimate carrying capacity of

---

[64] Appendix IX, Irrigation, Columbia-North Pacific Framework Study. 1971.

[65] Appendix VI, Economic Base and Projections, Columbia-North Pacific Framework Study. 1970.

1.2 billion or more recreation days annually.

d. Sustained Production Potential of Commerical Fisheries

The commerical production of fish and shellfish in the Pacific Northwest is based primarily upon the productivity of the adjoining continental shelves to a depth of 200 meters. The production of food for fish and shellfish is much higher in such areas, particularly where there is an upwelling of deep water that contains abundant mineral nutrients.[66] Such a condition prevails off the coast of Oregon and Washington. Dr. John Ryther of the Woods Hole Oceanographic Institution states that upwelling regions, totaling not more than one-tenth of one percent of the ocean surface, produce about half of the world's fish supply.

The total acreage less than 200 meters in depth (including Puget Sound) is about 8.5 million. According to Koblenz-Mishke, 1965, this area produces an average of about 200 grams of carbon (2,000 grams of wet organic matter) per square meter per year in the form of phytoplankton. Ricker[67] estimates the transfer efficiency in shallow seas from primary plant production to fish and shellfish production at 0.25 percent. On this basis, the sustained annual yield of fish and shellfish off the coasts of Oregon and Washington would be about 195,000 tons. Based upon the average 1965 value of fishery products of $310 per ton[68] the sustained yield value would be $60 million (raw fish and shellfish).

The 1965 commercial harvest was 87,724 tons valued at $27 million.[69] The value added due to local processing was about $45 million.

In summary, the commercial fish and shellfish harvest sustained yield potential appears to be about 150,000 tons (allowing 45,000 tons for sports harvest) with a 1965 value of $47 million. The potential value added due to local processing of fish products would be about $515 per ton or $77 million.

In order to maintain that productivity, however, it is essential that the Northwest estuaries and tributary watersheds be kept intact and healthy. At least two-thirds of the animal populations in the oceans spend an essential portion of their life cycle in estuarine waters or are dependent on species that do. This is doubly important in the Northwest because of the salmon and other anadromous fish.[70]

---

[66] *Food From the Sea,* by William E. Ricker—a chapter in the 1969 publication *Resources and Man,* by the National Academy of Sciences.

[67] Ibid.

[68] Fishery Statistics of United States, 1965, Statistical Digest No. 59.

[69] Ibid.

[70] The First Annual Report of the Council on Environmental Quality, Chapter IX, "Land Use-Coastal Zone," August 1970.

e. Sustained Production Potential for Industrial Activity Based Upon Location

There are a number of basic industries not primarily dependent upon the traditional resources of forests, farms, mines, and fisheries which have been established and are growing because a number of Northwest assets provide sufficient advantage in a competitive national and world market. Although not always so regarded, these Northwest assets are in reality renewable natural resources in the form of geographic location on the Pacific rim, excellent seaports and other transportation, abundant high quality water, low cost hydroelectric power, a moderate climate, ample available land for urban and industrial expansion, plenty of open space and a high quality outdoor environment for the enjoyment of management and employes.

Basic Northwest industries which presently are dependent upon these types of natural resources include (1) metal and machinery industries which import ores, such as aluminum and steel; (2) electrical machinery and equipment; (3) transportation equipment, including the aerospace industry; (4) textiles and apparel; (5) printing and publishing; (6) chemicals and allied products; and (7) miscellaneous.

In 1966 about 14 percent of the Pacific Northwest employment was in the above seven categories of industry.[71] A rough approximation of the value of this production in 1965 was 14 percent of the gross regional product of $20.5 billion[72] or $2,860 million.

The potential for further expansion of Northwest industrial activity based upon location is very difficult to predict. The necessary basic studies have not been made. The probable limiting factors, other than competition from other regions of the nation and the world, would be the availability of energy, the number of good sites suitable for the location of industrial plants, and a progressive decline in the quality of the physical environment as population and industry increase.

2. Nonrenewable

a. Sustained Production Potential of Mining and Materials

The region, including the adjacent continental shelf, is well endowed with mineral resources. Production has been a significant factor in the economy for 100 years. Ore reserves frequently are not in the most convenient location, but they are adequate to permit a sustained level of production for many decades (indefinitely for some minerals such as stone). Sustained yield principles do not apply to mineral ores. They are exhaustible. However, the useful lifetime of deposits can be extended for long periods by (a) limiting the rate of mining, (b) complete utilization of ore deposits, (c) progressive utilization of lower grade ores and (d) recycling of the minerals in discarded equipment. The value of mineral production in the region in 1965 was $388 million. Additional values were added as the result of refining, processing, and fab-

---

[71] Source: "The Pacific Northwest—A Study of Economic Growth in a Quality Environment," Vol. 1, Table 9, Battelle Memorial Institute.

[72] Personal income is assumed to be 79 percent of gross regional product. Northwest personal income in 1965 was $16.1 billion according to Bonneville Power Administration Personal Income Studies.

rication of these minerals within the region. Since the amounts added have not been compiled for all of the minerals, it was necessary to make some estimates based upon extensions of data that is available.

The mineral industry chapter in Appendix VI, "Economic Base and Projections" for the Columbia-North Pacific Region Comprehensive Framework Study, is the primary source of information. Additional information was obtained from the economic base studies published by the Bonneville Power Administration and other sources.

Although the Northwest is deficient in fossil fuels particularly oil and gas, the assumption is made that these energy sources will continue to be as available to the Pacific Northwest as to other parts of the nation.

The mineral production in 1965 and potential annual production which can be sustained for a period of 100 years is discussed below and summarized in Table 8.

(1) Nonmetals

(a) Oil and gas – No significant discoveries to date despite the drilling of 560 wells since 1902. However, geologic formations favorable to petroleum production total 70,000 cubic miles, mostly on the coasts of Oregon and Washington and adjacent continental shelves.[73] Only future drilling will provide the answers, but for the purpose of this paper no discoveries of major significance are projected.

(b) Coal – Estimated remaining reserves are 6,980 million tons of which 3,490 million tons are recoverable with existing economic conditions and technology. About 70 percent of the reserves are subbituminous coal; 85 percent of all reserves are in Western Washington. Huge reserves exist in adjoining regions in Montana, Wyoming, Utah, and British Columbia. Northwest coal production has declined from 8 million tons in 1910 to 190,000 tons in 1963. Employment declined to only 163 persons. Assuming that nuclear energy will supply an increasing amount of thermal electric power needs, coal supplies are adequate for long-term needs. Increasing amounts will be used for generating electricity. Eventually, coal may be converted into liquid or gaseous fuels.

(c) Sand, gravel and stone supplies are adequate for all foreseeble needs. Any local shortages in sand or gravel could be overcome by hauling greater distances and by crushing more stone (but at additional cost). Use is expected to increase in direct proportion to increase in gross regional product until a

[73] "Petroleum Potential of Western Oregon and Washington and the Adjacent Continental Margin," by Braislen, Hastings and Snavely, pending publication by National Petroleum Council.

Table 8 - Summary of Minerals from Pacific Northwest Ore Deposits

	1965 Production				Annual Production Sustainable for 100 Yrs. (More or Less)
		Value in Millions			
	Thousand Tons		Value Added[1]	Total	Thousand Tons
Nonmetals					
Coal (1963)	190	1.5	--	1.5	40,000
Phosphate Rock	3,879	22.7	93[2]	115.7	15,500
Sand, Gravel, Stone[3]	103,000	125.0	60[4]	185.0	415,000
Metals[5]					
Lead	80	25.0	--	25.0	100
Zinc	114	33.0	--	33.0	200
Copper	120	85.0	--	85.0	330
Nickel	13	19.0	--	19.0	13
Misc. Metals & Non-Metals					
		76.8	76.8[6]	153.6	
TOTALS		388.0	229.8	617.8	

[1] Due to processing, refinement, or fabrication in the Pacific Northwest of ores mined in the Northwest.

[2] Value of elemental phosphorus derived from Table 18 in BPA Base Study "Phosphorus."

[3] Includes limestone.

[4] Value added for limestone only.

[5] Recoverable metal content.

[6] Arbitrary figure.

plateau is reached. If we assume that ultimately the gross product in the Pacific Northwest will quadruple, the sustained annual production of sand, stone, and gravel would also quadruple.

(d) Phosphate – Production occurs primarily in Idaho and Montana. Phosphate rock ore appears adequate for foreseeable needs. The Northwest phosphate field is the nation's largest known reserve. In 1969 the Northwest produced one-third of the nation's elemental phosphorus. This is expected to increase to 50 percent by the year 2000. Other products manufactured include phosphoric acid; triple superphosphate; ammonium phosphate; and tricalcium phosphate used as an animal feed supplement.

(2) Metals

(a) Copper, Lead and Zinc – The ores are located primarily in the Coeur d'Alene district in Idaho (primarily lead, zinc, and silver) and the Butte district in Montana (mostly copper). Both areas have sufficient reserves to produce for many decades into the future. The long-term potential for zinc is particularly favorable due to low grade reserves in northeastern Washington. Presently all the copper ore is smelted in the region 85 percent of the lead, and 80 percent of the zinc.

(b) Nickel – Ore reserves appear to be sufficient to continue the 1965 rate of production of 13,000 tons for at least several decades. The only nickel plant in the U.S. is located in the region.

(3) Miscellaneous Metals and Nonmetals – (Uranium, silver, gold, chromium, molybedenum, mercury, manganese, antimony, tungsten, cobalt, rare earths, clays, barite, natural carbon dioxide, diatomite, perlite, vermiculite, pumice, soapstone, etc.)

Although deposits are known to exist and have been mined in the past and are currently being mined, the rate of mining is erratic due to market fluctuations and, in many cases, small or marginal ore deposits. Although the mining of individual ores will fluctuate widely, the average is expected to increase with the gross regional product until the value is quadrupled.

3. Ancillary or Secondary Industries

The assumption is made that this category of economic activity is generated by employment in basic industries discussed in 1 and 2 above. As per capita income from employment in basic industries rises (in constant dollars) the percentage of average income expended for the products of secondary activities also rises. In the secondary category are (a) contract construction of homes, industrial buildings, schools, highways, etc.; (b) transportation, communication and utilities; (c) wholesale and retail trade; (d) finance, insurance and real estate; (e) education;

and (f) government and miscellaneous.[74]

In 1966, about 62.6 percent of the total Northwest employment (including agriculture and self-employed) was in secondary industries. Assuming the same relationship, a figure of 62.6% X $20.4 billion or $12,770 million as the secondary industry contribution to gross regional product in 1965 is obtained.[75]

If average per capita income gradually increases to $7,500 (in 1965 dollars), it is reasonable to expect that the percentage expended for secondary industries will increase above 1966 levels; but the ultimate potential is impossible to pinpoint because of inadequate basic studies. Obviously it cannot reach 100%. Perhaps 70-80% will prove to be the ultimate ceiling.

B. Resource Use—Intangible Outdoor Environmental Purposes

The optimums and carrying capacities for the intangible outdoor environmental uses are discussed under "The Urban Environment" and "The Rural Environment," and are summarized in Table 4. In 1960 approximately 53 percent of the Pacific Northwest population resided in metropolitan areas. This increased to about 57 percent in 1970.

At one extreme are Class I urban recreation lands, such as city parks, playgrounds, and swimming pools. The average carrying capacity is about 3,000 recreation days per acre annually. But obviously, when the carrying capacity is exceeded, the quality of the experience to each individual decreases and the facility itself is often degraded.

At the other extreme are Class V wilderness or primitive areas. The carrying capacity in these areas averages only 1/2 recreation day per acre annually. But some of our dedicated wilderness areas are already being overused. For example, in March 1972, the Secretary of the Interior announced a trial program of limiting the number of people permitted at any one time in wilderness areas of Sequoia-Kings Canyon, Great Smoky Mountains, and Rocky Mountain National Parks in order to protect the quality of the wilderness experience and avoid physical destruction of the wilderness values.

1. The Urban Environment[76]

The Portland City Club report of August 8, 1969, regarding development of the waterfront contained the following quote: "A characteristic feature of our civilization is the city.

---

[74] With changes in the size of the geographic area under consideration adjustments may be needed in the composition of the "service" and "basic industry" categories.

[75] See Footnote 71.

[76] According to a 1969 Gallup Poll National Survey, the people of the United States regard the most pleasant places to live as follows (in percentages):

Rural area	30	Suburbs	18	Seashore	9	Other	1
Small city	25	Mountains	15 (11)	Large city	6		

Urban life is increasingly becoming America's culture. Although small-town America is still thought of by many Americans as the ideal life, more and more live in large cities. A major challenge is to make the city itself an attractive and exciting place for living by discovering, improving, and enhancing the features of urban life which are unique to it."

The qualities of cities are many and diverse, but to make the urban environment an enjoyable, pleasing, satisfying place to live, it must be improved. With over 70 percent of the people in the United States living in urban centers, planning for alternative levels of population must give first consideration to the cities. Despite dense use there are ecologically sound ways to manipulate the cities' environment that may also be economically and socially satisfactory in the long run.

This movement of people to the cities, including the Pacific Northwest, appears to be the result of human aspirations for a higher income, schools, medical services, transportation, cultural opportunities, the excitment, hustle and anonymity that have traditionally been a part of urban life.

Urban development has been based too often on what has been economically beneficial on the short term; there has been too little effective control of urban growth or development through either planning or management.

Preserving, enhancing, developing, and maintaining a pleasant environment within an urban area may be one of the most significant and positive steps toward attaining and maintaining a high quality overall environment for the Pacific Northwest. And per capita impact on the environment can be materially altered in urban areas through improved design, planning, and selective location of open areas.

Beyond the physical amenities required as for places to walk, to rest and reflect, an urban city must provide theaters, museums, art galleries, libraries, civic centers and parks. There is evidence that a well-designed city can add features and increase the use of facilities immeasurably over what has occurred up to now.

Indicative of the potentiality of this kind of thing is the use of the World's Fair grounds in Seattle. The World's Fair in 1962 provided permanent buildings and grounds that have continued as the Seattle Center. In this one central place within a metropolitan area are sports arenas, an opera house, landscaped park areas, an art gallery, an amusement park, and a range of restaurants from the most sophisticated to the hot dog stand. During the eight years it has been in operation it has demonstrated great capability for high-density enjoyment of a wide range of leisure-time pursuits. Individuals contemplating natural and especially man-made esthetics are commonplace; so is the small group enjoying its own music or discussion. This compact and wonderfully diverse place has appeal for both urban and rural visitors and serves millions annually.[77]

---

[77] 1965 5.3 | 1966 6.0 | 1967 7.0 | 1968 6.9 | 1969 7.6 (Attendance in millions) 1969 report, Seattle Center.

There are many features of the urban environment which can be further developed to make the city an amenable place to live, work, and play. Rapid transit, landscaped grounds around public and private businesses, urban recreational and athletic facilities, historical and cultural site reservation, open space, scenic walks and trails, night-time entertainment opportunities, shopping centers and malls, arts and skill centers are just a few.

> *If the aspirations which have drawn Americans to the city in the first instance, and subsequently from the city core to the suburbs, are often proving illusory, the solution does not lie in seeking escape from urban life. Our challenge is to find ways to promote the amenities of life in the midst of urban development; in short, to make urban life fulfilling rather than frustrating. Along with essentials of jobs and housing, we must also provide open spaces and outdoor recreation opportunities, maintain acceptable levels of air and water quality, reduce noise and litter, and develop cityscapes that delight the eye and uplift the spirit.*
>
> *President Richard Nixon*
> *August 1970*

Bureau of Outdoor Recreation Class I[78] – Urban Parks, Cultural, Recreation and Sports Centers, Open Space, etc.

One essential but often neglected portion of the urban environment is included in BOR Class I land. A benchmark optimum standard for this class is estimated to be 100 visits (average–3 hours each) per person per year or a total of 7,500 visits in a lifetime. This is about 75 percent of the total visits, or, on an hourly basis it approximately equals the combined total for the other five BOR land classes. The annual carrying capacity of urban parks is estimated to be 3,000 recreation visits per acre.[79] In 1965 the inventoried Class I lands totaled 20,000 acres with an annual capacity of about 60 million visits compared to a benchmark standard of 191,000 acres capable of accommodating 580 million annual visits for the population of 5.8 million. The actual condition is less disparate, however, since the private lands in Class I, such as golf courses, race tracks, etc., have not been inventoried, and greatly increase the carrying capacity of inventoried Class I lands. Also portions of the urban outdoor and indoor recreation needs are interchangeable. More complete study and observation might reveal that as much as half of the 100 recreation visits per year tentatively assigned to Class I areas actually should be for indoor recreation such as opera and the theatre.

The highest priority need is to insure that adequate uncommitted lands in urban areas are dedicated permanently to recreation and open space purposes. Deficiencies in Class I acreages in individual urban areas may reduce the livability in those particular urban centers. However, in the Pacific Northwest these deficiencies could be corrected by land acquisition, by establishing greenbelts, by discouraging the growth of some existing urban complexes and encouraging urban centers with ample dedicated open space and recreation areas from the

---

[78] Appendix I includes definitions of BOR Classes I – VI.

[79] From Appendix XIII, Recreation, Columbia-North Pacific Framework Study.

inception. Thus, since ample open land presently can be obtained and developed so that it qualifies as BOR Class I, that class should not place a physical constraint upon the future growth of the Northwest region as a whole under conditions of optimum livability. The need is for adequate organization, administration, and funds.

2. The Rural Environment

BOR Classes II through V are located primarily in nonurban areas. Class VI, historic and cultural sites, occur in both urban and rural areas. These latter generally are small and are used as intensively as Class I, urban recreation lands.

Recreation programs of state and federal agencies in the western states have been oriented primarily toward rural recreation lands, probably because of their abundance, their low cost, and their high quality. Population centers in the Northwest are located within easy travel distance of the entire range of rural recreation opportunities.

Interest in and usage of all classes of rural recreation lands in the West has accelerated at a very rapid rate during the past 10 years. Also the pattern of use has been changing rapidly. There has been increasing use of primitive areas with a minimum of equipment on the one hand and a vast upsurge in the development of resort areas and the use of sophisticated equipment such as campers, trailers, power boats, snowmobiles, off-road vehicles, and ski tows on the other. The classes of recreation land which require large acreages and can tolerate only a very limited amount of human use are wildlife areas, wilderness areas, outstanding natural areas, and wild and scenic rivers. Since the land potentially available for such uses is finite, it provides constraints upon the total Northwest population that can be accommodated under conditions of optimum livability (Table 4). Developed recreation facilities in urban and rural settings provide a valuable part of the intangible needs of man but they can never be a substitute for the wilderness, scenic rivers, outstanding natural areas, and wildlife.

BOR CLASS II, Rural Sites

These are typically state and county parks and Bureau of Land Management and National Forest developed recreation sites.

The annual carrying capacity is estimated to be 250 visits (averaging eight hours each) per acre. At the benchmark standards it is estimated that the average person would visit a Class II area an average of four times each year or a total of 300 visits in an average lifetime.

In 1965 the BOR inventory included 913,000 acres of land in this class. A large, but unknown portion of this acreage, although dedicated, lacked developed facilities. The dedicated acreage, if fully developed, and properly distributed is judged adequate for a regional population of 10 million. However, the usage of Class I and Class II lands is more or less interchangeable depending upon distance from urban centers. Obviously the shortage of outdoor recreation opportunities in Pacific Northwest urban centers is currently being offset by usage of nearby rural sites.

BOR Class III, Multiple Use Management Areas

As shown in Table 4, the 77 million acres in this class comprise over 85 percent of the dedicated recreation land in the region. Typically it consists of land under BLM, Forest Service, or state jurisdiction with no developed facilities except roads or trails and no permanent habitation. It includes a wide range of recreation values from flat desert valleys to wild rivers and spectacular alpine scenery. Three subcategories of this class which are essential for an optimum environment but have a limited acreage and limited potential for expansion are shown separately in Table 4. These are hunting and wildlife observation areas, fishing areas, and free-flowing rivers.

In addition to the dedicated lands there were about 60 million acres, mostly of privately owned forest, grazing and farm lands, which were available for some public use. However, there is no assurance that such public use will be allowed in the future.

The annual carrying capacity is estimated to be one visit per acre (average eight hours) and the benchmark annual visitation at 12 visits per person (including sightseeing) or 900 visits in an average lifetime.

Class III lands (except for sub-classes a and b) are judged adequate for Pacific Northwest residents at the present time, but (if an optimum environment is maintained, an additional 43 million acres would need to be dedicated to provide for 10 million residents). Some of this additional need could be satisfied by developing more facilities in Class II areas.

BOR Class III a, Wildlife Management Areas

This sub-class includes areas devoted primarily to the protection and production of wildlife for public enjoyment—for hunting, fishing, scientific study, observation, photography, etc.

The first essential is that there be no net reduction in the habitat available for fish and wildlife in 1965. This habitat consisted of nearly all the Class III, IV, and V lands whether dedicated or not. It includes in excess of 100,000 miles of fishable streams and about 1,272,000 acres of land in wildlife refuges, wildlife management areas and wildlife facilities.[80] On a regionwide basis, fishing is judged at or near the benchmark standard and wildlife conditions about 25% below the benchmark. Conditions varied considerably within the region from near benchmark conditions in Idaho to perhaps 30 to 40% below in Washington for wildlife (see column 8, Table 4).

Any appreciable increase in fish and wildlife habitat above 1965 levels can be attained by devoting more suitable land and water areas to improving the habitat for the primary

[80] Appendix XIV, Fish and Wildlife, Columbia-North Pacific Comprehensive Framework Study.

purpose of fish and wildlife production—in other words, more fish and wildlife management areas. The addition of such fish and wildlife areas might reduce the agricultural productivity of the farming and grazing lands dedicated to wildlife and make most remaining good fishing streams unavailable for larger scale hydropower production, reclamation diversions, etc.

a. Hunting and Wildlife Observation

In 1965 the average annual participation was 1.8 hunting visits per resident. At least as much, probably more, time was spent in wildlife study, photography, and other nonconsumptive uses for a total of 3.6 visits. A benchmark standard is judged to be at least four visits. One acre of good land devoted to wildlife management will support on the average about two hunting and wildlife observation visits annually. In 1965 the deficiency in wildlife management areas under benchmark standards was about 4 million acres. With a regional population of 10 million, about 12.4 million acres of new wildlife acres in addition to the 1965 base would be necessary. This amount of land potentially is available. However, since it would involve the acquisition of privately owned farm, forest, and range lands, practical considerations may preclude its realization.

b. Fishing

In 1965 the average annual participation was 3.8 fishing visits per capita. This includes ocean fishing, anadromous fish and shellfish, as well as resident fish. This is assumed to be at or near the benchmark standard. The most potential for increasing the fishing for resident game fish in the future to accommodate more population appears to be lakes and reservoirs. An average acre of fishing lake or reservoir in the Pacific Northwest now produces about 20 fishing visits annually. However, many reservoirs constructed for the primary purpose of power production, irrigation, etc., provide a poor fishery. In fact, reservoirs which result from impounding a free-flowing stream which provided a high quality salmonid fishery and substituting a lower quality warm water fishery may cause a net loss of fishing values. Also large, deep reservoirs seldom result in an increase in the fishery proportional to the acreage of surface water. Consequently, the largest acreage counted for one new fishing lake is 2,000.

In 1965 there was no overall regional deficiency in fishing opportunities. For a regional population of 10 million to have the benchmark standard fishing, 840,000 surface acres in a minimum of 420 fishing lakes, in addition to the 1965 base, would be necessary. An additional 400,000 surface acres would be needed to accommodate an estimated 20 percent non-resident use. An alternative would be to improve the quality of the fishery in many of the existing lakes and reservoirs.

BOR Class III b, Free Flowing Rivers

This sub-class includes wild, scenic, and recreation rivers, including adjacent corridors of land averaging 1/4 mile on both sides, or a total of 320 acres for each mile of river.

The annual carrying capacity of free-flowing rivers has not been established. However, the best available estimated average for all three categories is 4,000 visits per mile of river (or

320 acres of corridor). This converts to 12.5 visits per acre of corridor. Under benchmark conditions it is estimated that the average person would spend an annual average of two visitor days (eight hours each) on a wild, scenic, or recreation river. The lifetime total would average 150 visits.

Another alternative potentially could be increases in the supply of anadromous fish in the ocean and in selected rivers and streams. These increases could be the result of using improved techniques for artificial propagation, for passage of migrating fish around dams, and for improving water quality in rivers and streams used by the anadromous fish.

National and State programs to dedicate free-flowing rivers commenced in 1968. In 1970 there were 2,580 miles (826,000 acres of corridor) of instant and "study" rivers designated in the Pacific Northwest. An additional 7,570 miles (2,422,000 acres of corridor) with potential for future designation had been identified.[81] This is approximately the total supply that will ever be available. In 1970 the combined total for dedicated and study rivers was 320 miles (102,000 acres of corridor) short of the total judged needed for resident use under benchmark conditions. If the regional population increases to 10 million, a total of 2,420 miles (774,000 acres of corridor) would be needed in addition to the 1970 base. This is available. However, if non-resident use is 75 percent, about 6,170 miles (1,974,000 acres of corridor) would be needed in addition to the 1970 base. This is within 1,400 miles of the total supply potentially available.

BOR Class IV, Outstanding Natural Areas

Examples include portions of Yellowstone, Grand Teton, Crater Lake, Rainier, North Cascades, and Olympic National Parks, Columbia River Gorge, Salmon and Snake River Canyons, Bruneau and St. Anthony Sand Dunes and parts of the Skagit and Rogue River Canyons. The carrying capacity is estimated to be 25 visits (average eight hours each) per acre per year. Under benchmark conditions it is estimated that the average person would visit a Class IV area an average of six times each year or a total of 450 visits in an average lifetime.

In 1965 there were 2,935,000 acres in dedicated Class IV lands, 99 percent in federal ownership. The present acreage (it includes both dedicated and non-dedicated land) is all that will be available. Superficially, it appears adequate for a regional population of 10 million under benchmark conditions and could accommodate an additional non-resident usage up to 25 percent. Actually, only a very small portion appears to be suitable for development and heavy visitation as Class IV lands. Much of the National Park land is suitable for and may be dedicated as wilderness. Such action would reduce the assumed carrying capacity of the Class IV lands in the region since wilderness (Class V) has only 2 percent of the carrying capacity of Class IV lands.

---

[81] Appendix XIII, Recreation, Columbia-North Pacific Comprehensive Framework Study, and Table 4.

BOR Class V, Wilderness[82]

Dedicated acreage in this class has been formally included in the national wilderness preservation system. The 6.3 million acres dedicated in 1965 was in National Forests. The 5.6 million acres potentially available that probably will qualify include additional identified areas in National Forests, National Parks, wildlife refuges, and public domain areas administered by BLM. The total of approximately 12 million acres is all that will be available.

The annual carrying capacity is estimated to be 1/2 visit (24 hours duration) per acre. The usage under benchmark conditions is estimated to be one visit of five full days' duration each 15 years or a total of 25 days in an average lifetime. In 1965, based upon resident use only, there was a surplus of 2.9 million acres. The existing dedicated areas would be adequate for a regional population of 10 million. However, with a non-resident use of 50 percent, an additional 2,680,000 acres would be required. This would leave about 3 million acres of additional acreage potentially available.[83]

BOR Class VI, Historic and Cultural Sites

These sites are usually small in size. Examples are Fort Clatsop, Fort Vancouver, Champoeg State Park in Oregon, and Cataldo Mission in Idaho.

When fully developed the annual carrying capacity is similar to Class I Areas. Average per capita usage under benchmark conditions probably is of little significance. However, a figure of two visits (three hours each) was used in Table 4. The importance of this class rests upon the cultural and historic heritage that is suitable for preservation. The Northwest appears to be endowed with sufficient areas to easily accommodate a resident population of 10 million.

[82] Ibid.

[83] Although the acreage of dedicated wilderness land in 1970 appears to be more than adequate for a Northwest resident population of 10 million, the suggested additional acreage needed to supply the requirements of non-residents (5 million) may be less than adequate from the standpoint of the nation as a whole.

Appendix 7

POTENTIAL FOR RECYCLING WASTES[84]

Once the fact is accepted that an ever increasing affluence and an ever increasing population in a region or nation is running into a resource deficit, the first alternative frequently chosen is to import raw materials. A second alternative is to accept a decline in the standard of living. A third alternative, which has been wantonly overlooked in this era of throw-away containers and instant and convenience packaging, is the salvage and recycling of solid, liquid, and gaseous wastes. Such wastage results not only in squandering resources, but also requires that additional finances and effort be devoted to disposing of the wastes in a way that does not adversely affect the environment. These "wastes" in reality are valuable natural resources which should be reused rather than discarded. However, such reuse frequently requires the consumption of energy—a resource that cannot be recycled.

At the present time, out of the 36 most important raw materials consumed by the manufacturing industries, the United States is self-sufficient in only ten and must import all or part of the requirements of the other 26 materials.[85]

United States
(Self-Sufficient)

Coal	Vanadium
Uranium	Bromine
Molybdenum	Sulfur
Magnesium	Phosphate rock
Titanium	Cotton

United States
(Not Self-Sufficient)

Iron ore	Manganese	Fluorspar
Copper	Tungsten	Potash
Lead	Silver	Petroleum
Zinc	Gold	Natural gas
Tin	Platinum	Leather hides
Nickel	Diamonds	Wool
Cobalt	Aluminum ore (bauxite)	Lumber
Mercury		Wood pulp
Chromium	Asbestos	Natural rubber

On the other hand, there have been recent increases in efforts toward developing

---

[84] Smith, Frank Austin, "Waste Material Recovery & Reuse", A Chapter in Vol. III, "Population, Resources and the Environment" edited by Ronald Ridker for the Commission on Population Growth and the American Future, USGPO 1972.

[85] "U.S. Will Lag USSR in Raw Materials," by Raymond Ewell, *Chemical and Engineering News*, August 24, 1970.

degradable materials which will not result in litter or pollution, and toward conserving our resources by salvaging as much material as possible for reuse and recycling. Directly tied in with salvaging and recycling are disposal methods used for solid, liquid, and gaseous wastes.

It is estimated that the value of recoverable materials in solid wastes are in the range of $12 to $20 per ton; this is also in the range of present costs for disposal. Current methods for disposal of solid wastes include sanitary land fill, incineration, chemical processing, and composting of organic material.

A. Available Technology

Across the nation there are many examples of pioneer or experimental processes that are being installed for recycling wastes. While many of these will not prove to be ultimate solutions, they illustrate the potential. A plant costing $10 million currently is being built in Delaware[86] which will handle 500 tons per day of domestic and industrial refuse and 70 tons per day of sewage sludge. Everything in the feed will be recovered. The following waste categories will be separated, recovered, and utilized: (1) ferrous metals; (2) nonferrous metals; (3) glass, grit, and organics (separated by screens, gravity tables, and other equipment). A digester will convert part of the organics to animal food additives and combine other parts with powdered glass and grit to make compost or humus for soil additives. Other organics not digested will be converted by pyrolysis to oils and tars for fuels or other uses. Cost of operation is estimated to be $5 to $6 per ton, exclusive of haulage.

Through State and local and community efforts, Idaho has embarked upon extensive efforts to remove junk and abandoned cars from its landscape. During the first six months of 1970, 23,721 tons of scrap steel, mostly from automobiles, was shipped from the State of Idaho. Based on a $20 per ton price, this indicates a return to Idaho's economy of $474,420 for the six months' period. The State estimates 40,000 tons of automobile junk are entering the junkyards each year. Idaho hopes by the close of 1970 to be averaging out approximately 60,000 tons per year leaving the State. This would then temporarily place Idaho in a position of having exported more tons of scrap than is accumulating per year. This scrap is hauled to steel mills, reprocessed and recycled for further economic development.[87]

As soon as the enforcement of air quality standards results in cleaning up of stack gases from burning of fossil fuel and other combustion, much of the sulfur compounds which were formerly broadcast over the landscape will be recovered and utilized to manufacture fertilizer, sulfuric acid,[88] and other sulfur products.

In recent years, by sharply reducing the pollution load, Lake Washington and the Willamette River have regained good quality water—better in 1973 than in 1941.

---

[86] "Reclaiming Solid Wastes for Profit," *Environmental Science and Technology*, September 1970; also in *Chemical Engineering*, July 13, 1970, pg. 25.

[87] Progress Report Junkyards, Deputy Highway Engineer, State of Idaho, July 16, 1970.

[88] "Chemical Firms Focus on Waste Recovery," *Chemical and Engineering News*, August 3, 1970.

Thanks to an assist from Dow Chemical,[89] plastic milk bottles and other products made of high density polyethylene are being made into agricultural drainage tile. The value of this type of reclaimed material is $120 to $160 per ton; it can be recycled and reused many times for many purposes.

In the Los Angeles area[90] from April to August 1970, the Glass Container Manufacturers Institute boasts that it paid $40,000 for over 8 million bottles turned in and that the rate is now one million bottles and jars a week. The bottles are crushed, melted, and made into new bottles. A similar recovery is being made of aluminum beverage cans at a cost of 1/2 cent per can.

The Louisiana State University[91] is operating a $20,000 chemical-microbial pilot plant using cellulose waste to make high protein animal feed. The techniques can be adapted to work on other castoffs such as straw, corncobs, newspapers, and other cellulose products.

W. R. Grace has developed a process to remove the bulk of phosphate materials in municipal sewage which will be attractive fertilizers on a break-even or profit-making sewage treatment plant.[92]

Research and pilot plant operations are showing promise of "closing the loop" on wastes from cattle feedlots by making high protein feed that is fed back to the cattle.

An offshoot or byproduct of the space age is the recycling or reuse[93] of waste body fluids as a water supply after treatment and recovery.

Another interesting recovery is made when treating sewage sludge with sulfur dioxide. In addition to reducing the volume of sludge in half, a high protein "syrup" suitable for livestock feed is produced.

The Adolph Coors Company reports that about 30 percent of its beer cans are being returned and salvaged for their aluminum content. Companies in the Northwest are initiating similar programs for bottles and cans.

In 1969 the United States consumed about 58.8 million tons of paper and paperboard.[94] About 21 percent of the paper produced was recycled. The 1969 production is predicted to double in 16 years with recycling expected to increase to around 45 percent.

In 1969 the Federal Water Quality Administration committed $2 million for a project

---

89 "Waste Recovery . . . ," *Chemical and Engineering News*, August 24, 1970.

90 "Water Pollution Conclave . . . ," *Chemical Engineering*, September 7, 1970.

91 "Turning Trash Into Profit," *Water Newsletter*, July 22, 1970.

92 "Something Saved," *Chemical and Engineering News*, May 25, 1970.

93 "Water Pollution Conclave . . . ," *Chemical Engineering*, September 7, 1970.

94 "Waste Recycling Really Works," *Environmental Science and Technology*, October 1970.

to demonstrate that sewage and factory effluent now being dumped into Lake Michigan can be diverted to enrich low value farm and forest land in Michigan.

The emphasis is switching from total exploitation of natural resources to total reclamation. To environmentalists who previously would have settled for pollution control and safe disposal, the watchwords now are "recovery," "recycle," and "close the loop." Where waste products cannot be economically recovered, long-established processes face displacement by alternate methods, some of which have been around for years. Companies that extract and market chemicals from natural sources and at the same time dump the same chemicals as waste by-products from synthetic processes are having to rethink their methods and processes.

B. Present Practices

Although the technology is available for cleaning the United States' environment, it is obvious to everyone that we have only begun to do so. One of the reasons for past environmental deterioration is the fact that we have treated clean air, clean water, and an unsullied landscape as if they were free and available for the dumping of our wastes. Prior to about 1930 there was no great harm done because our level of wastes, except in localized areas, was within the limits of the natural systems to assimilate them.

Since 1950 the real output of goods and services in the United States has exceeded the total for the previous 330 years since the landing of the pilgrims.[95] In our modern, urban, industrial society the ability of our natural systems to assimilate wastes is being overwhelmed on a regional and even a national basis. One result is that production which spawns pollution creates goods that are underpriced because the producer does not pay for pollution abatement that would prevent environmental damage. Such a situation both warps the price structure and encourages more pollution. Present recycling is far short of the potential. For example, it has been estimated that in 1969 only 45 percent of the iron and steel, 42 percent of the copper, 25 percent of the zinc, 21 percent of the paper, and 13 percent of the rubber was recovered and used again in United States' production. Probably not more than 10% of all solid, liquid, and gaseous "wastes" were recycled.

1. Solid Wastes

In the United States in 1969, Americans threw away more than 250 million tons of residential, commercial and institutional solid wastes. About 190 million tons were collected (at an average cost of $14 per ton plus $4 for disposal). The remainder was abandoned. Of the amount collected, 60 percent was placed in open dumps; 25 percent in sanitary landfills; about 1-1/2 percent was salvaged or composted. Industrial wastes totaled 110 million tons; mineral wastes—1,700 million tons; and agricultural wastes—2,280 million tons.[96] Almost none was recycled, except for a small percentage of agricultural wastes.

---

[95] Edwin L. Dale, Jr., "The Economics of Pollution," *Congressional Record*, S20532-4, December 17, 1970.

[96] Bureau of Solid Wastes Management, HEW: Bureau of Mines, USDI.

The solid waste situation in the Pacific Northwest is comparable to that for the United States as a whole.[97]

Although no comprehensive and authoritative studies are available for reference, an estimate from partial information is that the expenditures per year shown in Table 9 would be sufficient to either recycle most of our solid wastes or dispose of them in a manner that would cause no short range or long range damage to the environment.

2. Gaseous Wastes

In 1968 about 215 million tons of pollutants were dumped into the atmosphere over the United States: 42 percent from transportation, 21 percent from heating, 14 percent from industry, and 23 percent from other sources. The damages from this pollution have not been precisely calculated, but amount to many billions annually (annual damage to fabrics has been estimated at $800 million and to agricultural crops, $500 million).

The total investment and operation costs to control and recycle the worst of this air pollution from six pollutants—particulates, sulfur oxide, carbon monoxide, hydrocarbons, flouride, and lead—in 298 metropolitan areas have been estimated to be about $4.8 billion per year or about $22.50 per capita for the entire United States population in FY 1976.[98] With a doubling of the per capita share of gross national product this would increase to about $45 per year. Extending high quality air pollution controls to the entire nation and including all pollutants would approximately triple the costs to about $150 per year.

3. Liquid Wastes[98]

The amount of money and effort needed to clean up and recycle the wastes being dumped into our water, and keep it clean, is substantial. Both direct and indirect (preventive) costs are involved. For the United States as a whole, annual investment and operating costs for needed municipal waste treatment plants are estimated at $30 per capita; industrial wastes, $20 per capita; agricultural wastes, uncertain but estimated at $10 per capita; and sedimentation control, also uncertain but estimated at $20 per capita. The total annual cost of clean water in 1970 then is about $80 per capita. With a doubling of our per capita share of gross national product, the annual cost should approximately double to about $160.

---

[97] "Solid Waste Practices in Oregon," August 1970 issue of *Oregon State Board of Health Bulletin.*

[98] First and Second Annual Reports, Council on Environmental Quality.

Appendix 8

FOUR AREAS IN CALIFORNIA

A. Santa Clara County

An area in California which has received publicity because of its alleged overdevelopment is Santa Clara County. Karl Belser, the County's planning director from 1950 to 1967, states his views of what happened.[99]

"In 1940 . . . Santa Clara County called itself 'the Valley of Heart's Delight.' It was beautiful; it was a wholesome place to live; and it was one of the 15 most productive agricultural counties in the United States . . .

" . . . and it was during this period of transition between 1950 and 1955 that the county began to be inundated with the surge of new development. The innovations in government structure were simply not strong enough to withstand (even if it had been desired) the rapidly developing and overpowering urban pressure.

" . . . corollary to this is the fact that in 1950 the City of San Jose came under a new, aggressive administration which made no bones about its goal of making San Jose the Los Angeles of the north . . . and moved with alacrity to implement (that goal) . . .

"Speculators took over and pushed the county into uncontrolled development. The behavior of all elements of the community can best be described as pandemonium. Wild urban growth attacked the valley much as cancer attacks the human body . . . Misled by the fiction that growth and development would lead to economic solvency, government sold out to business and industry by making concessions inimical to the public interest as inducements for development investment, while the power structure, led by financial institutions, the media, the wealthy urban property owners and the business community, exploited the situation to make huge profits. In less than 20 years the valley became the home and place of work for more than a million people . . . Not only was the new development an encroachment on the prime agricultural land, but the result was uneconomical, wasteful, and fiscally insolvent mess . . .

"Roads and freeways already overtaxed will unquestionably become nightmares of traffic. Yet the random development pattern defies solution of its transportation needs by systems of mass and rapid transit. Most important of all for people trapped in this net is the steady erosion of most of the qualities of the environment . . ."

B. The Los Angeles Area

California's south coastal area provides another example of rampant growth colliding

---

[99] "The Making of Slurban America," *Cry California*, the Journal of California Tomorrow, Fall, 1970.

with natural environmental constraints. This area is expected to grow from the present 11.8 million people to 20 million by the turn of the century. The California Water Plan, for example, is based upon that assumption. But in the opinion of Prof. Mark von Wodtke, "There is a massive flaw in all these plans in that . . . the finite limitations of air, water, and land resources have not been measured. There is enough evidence at hand today to conclude that the air resource of the Los Angeles Basin simply will not support a population of more than about 14 million, even assuming that the optimistic pollution levels predicted . . . can be achieved . . .

"Planning for any region must be based upon the carrying capacity of the resources of the region itself . . . Natural limiting factors (in addition to air)—water, food, and land—will all have to be weighed eventually to determine the ultimate carrying capacity of the Los Angeles region . . .

"Nor has the necessity of preserving open lands for agriculture, recreation, watershed management and so on, ever been carefully weighed by the cities and counties of the south-land, or by the State government. There is a finite amount of land available for these purposes, yet if trends which are reflected in current planning continue, the possibility of putting aside the vast acreages necessary to create a wholesome balance between urban build-up and open space will be for practical purposes non-existent . . ."

"Would the costs of comprehensive planning, of inventorying our resources, of developing good resource-consumption models based on a steady state in each natural area, of implementing plans that would maximize the benefits of the resources in each area—would these costs be more, in terms of money and energy spent, than the costs of crisis if we continue our present course? Or are we really such a primitive society that our only option is to foul our nest, then flee?"[100]

C. Napa County[101]

Napa is one of the counties bordering San Francisco Bay on the north. Its rich bottom lands and rolling foothills support many vineyards and wineries—one of the few places in the world where the finest wine grapes can be grown. Due to its rougher topography and the lack of freeways the Napa Valley escaped the rampant urbanization that hit the Santa Clara Valley in the 50's and 60's.

But the freeways are now on the drawing boards, and a U.S. Department of Commerce study predicted a tenfold increase in Napa County population within 50 years. Its area is 370,000 acres with a population in 1970 of 79,000—a ratio of 4.7 acres per capita.

---

[100] "The Carrying Capacity of the Los Angeles Basin," *Cry California*, Fall, 1970.

In a January 8, 1973, UPI Story, Mr. Conrad C. Jamison of the Security Pacific National Bank, an urban economist and one of the leading authorities on Southern California population shifts, was quoted as stating: "Up to 100,000 residents a year are moving out of the county without replacements." In the summer of 1972 the California Department of Finance reported that the population of Los Angeles County had dropped about 76,000 since the 1970 census.

[101] Information furnished by Mr. James Hickey, Director of Planning for Napa County.

But the people of Napa Valley decided they do not want more urbanization; they want to preserve their prime agricultural land, open space and scenic beauty. In addition to encouraging voluntary ten year agreements to maintain farm lands under California's Williamson Act of 1965, the County Board of Supervisors in 1968 adopted an ordinance establishing a system of agricultural preserves which prohibits subdividing land in lots less than 20 acres. The initial 25,000-acre preserve takes up the entire main Napa Valley and its prime agricultural land. Presently the agricultural preserve enjoys near unanimous public support. In addition, any kind of subdivision outside present city limits and not in the agricultural preserve requires approval as a county service area involving water supply, sewage disposal and other utilities, density, etc.

The Napa County zoning plan provides for a very carefully coordinated recreation area around Lake Berryessa in eastern Napa County and an industrial area in southern Napa County. However, sentiment in opposition to the proposed north-south freeway trhough the main Napa Valley is extremely strong—so much so that a bill was introduced in the 1971 California legislature which would forever prohibit such a freeway.

D. San Francisco Bay Area

In 1970 the Association of Bay Area Governments (ABAG) approved a general plan which would preserve about 3 million acres as permanent open space. An additional 660,000 acres would be held in reserve for future controlled development. The total is about ten times the amount of open space presently in public ownership. The plan is to preserve the land by a combination of zoning and land acquisition at an estimated cost of $2 billion (1969 prices). The open space lands would be dedicated for the following purposes: (1) Resource preservation (forests, tidelands, cliffs, etc.,); (2) Resource production (agricultural lands, estuary areas for fish production, etc.,); (3) Health and welfare (municipal watersheds, recreation areas, solid waste disposal sites, buffer zones to reduce noise, etc.,); (4) Public safety (flood plains, drainage channels, earthquake fault zones, landslide areas, firebreak areas, airport zones, etc.,); (5) Utility corridors (transportation, power, water, fuel, etc.,).

Summarization of Comments Received on the E & E Discussion Draft

Attitude Toward the E & E Report	Federal Agencies	State Agencies	Regional Local, or Intergovt'l Bodies	Academic Bodies	Conservation and Service Groups	Industry	Quasi Public Groups	Public at Large	Consulting Firms	Research Organi-zations	Total
1. Favor study effort and application of carrying capacity as presented in report	20	7	1	8	9	1	2	7	5	2	62
2. Favor study effort and general application of carrying capacity presented in report but making criticisms and/or recom mendations of certain elements	19	6	4	16	10	1	0	6	3	2	67
3. Favor study effort, but suggest limiting the application of carrying capacity to the natural environment	7	3	0	4	0	0	0	2	1	2	19
4. Oppose application of carrying capacity to long-range planning, but desire study effort continued	2	0	0	0	0	1	2	1	0	0	6
5. Oppose study effort	3	1	0	0	0	1	0	0	0	0	5
6. Oppose study effort with criticisms and/or recommendations	5	0	0	1	0	4	0	0	0	0	10
7. Non-committal	8	2	0	2	0	0	3	0	0	1	16
										Total	185
8. Those commenting offering assistance	0	0	0	5	2	0	0	1	0	0	8
9. Total of comments favoring continuation of study effort (1-4)	48	16	5	28	19	3	4	16	9	6	154
10. Total of comments opposing any further continuation of the study effort (5-6)	8	1	0	1	0	5	0	0	0	0	15
11. Total responses	64	19	5	31	19	8	7	16	9	7	185
12. Percentage responding	10%	6%	5%	15%	9%	4%	8%	18%	31%	60%	10%

pacific northwest river basins commission
1 columbia river • p. o. box 908 • vancouver, washington / 98660

PIONEER PRINTING - VANCOUVER, WASHINGTON